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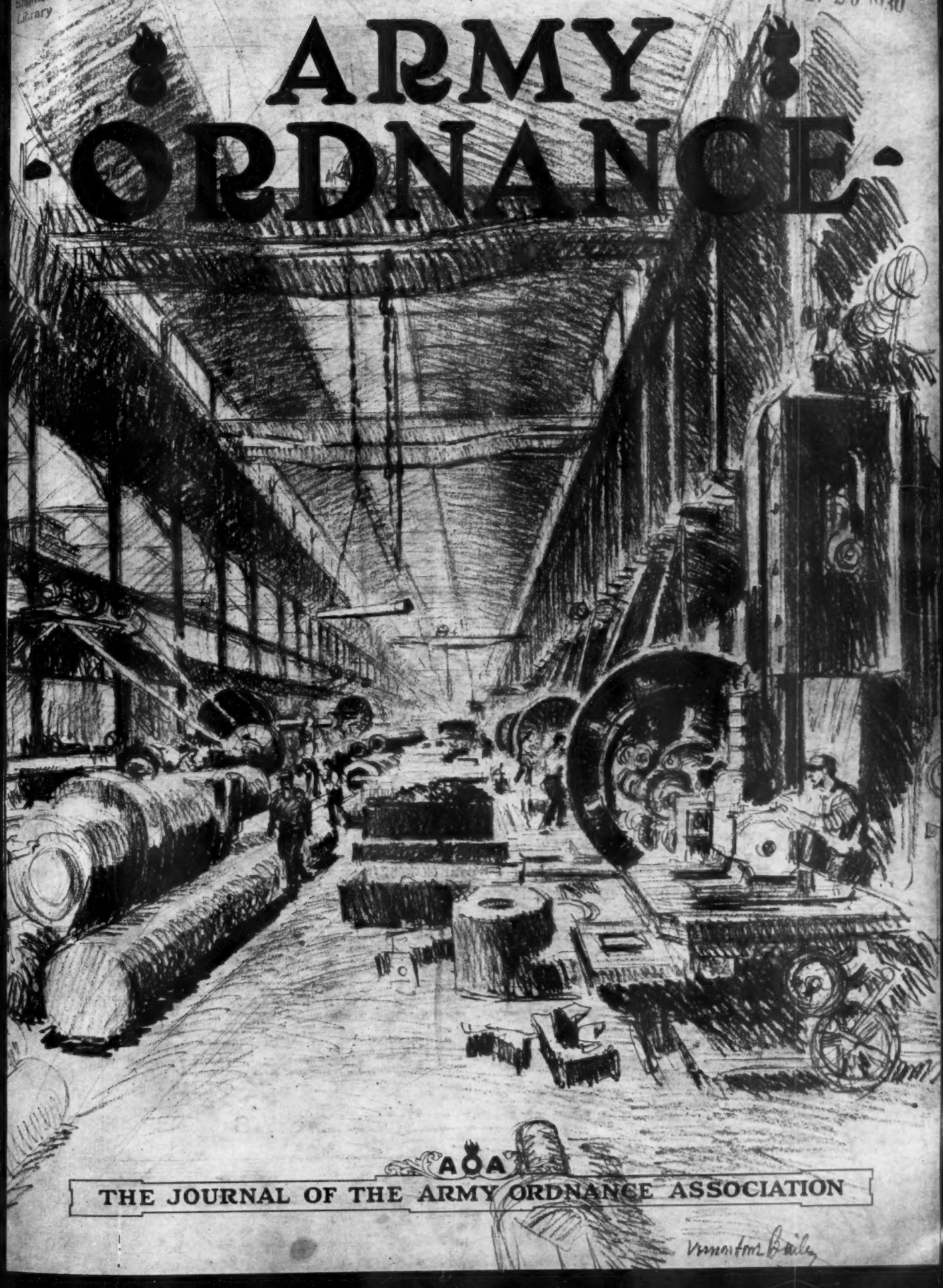

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ARMY ORDNANCE

The Journal of the Army Ordnance Association

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

Published by the Army Ordnance Association, The Mills Building, Washington, D. C. L. A. Codd, Editor.

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"The industrial war plan must conform to the living body of industry—to its customs, practices, organization and character. No human mind can grasp every detail. It can only be developed by years of labor and research. Occupying the space between the continuously changing body of industry and the intermittently changing war plan, it must slowly shape itself to each."

—Patrick J. Hurley, Secretary of War.

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ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the Nation's strongest guarantees of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the Nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect cooperation with American Scientists, Inventors, Engineers and Manufacturers in civil life and the Regular and Reserve Officers of the Army Ordnance Department;

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

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Advocate of Industrial Preparedness and Eminent Ordnance Authority who Retired from Active Military Service August 31, 1930, after 44 years of Noteworthy Activity. At the Time of his Retirement General Ruggles was Assistant to the Chief of Ordnance and Head of the Manufacturing Service of the Ordnance Department.

ARMY ORDNANCE

VOL. XI SEPTEMBER-OCTOBER, 1930 No. 62

Testing Our Military Armament

Recent Developments at the Aberdeen Proving Ground

By E. M. Shinkle*

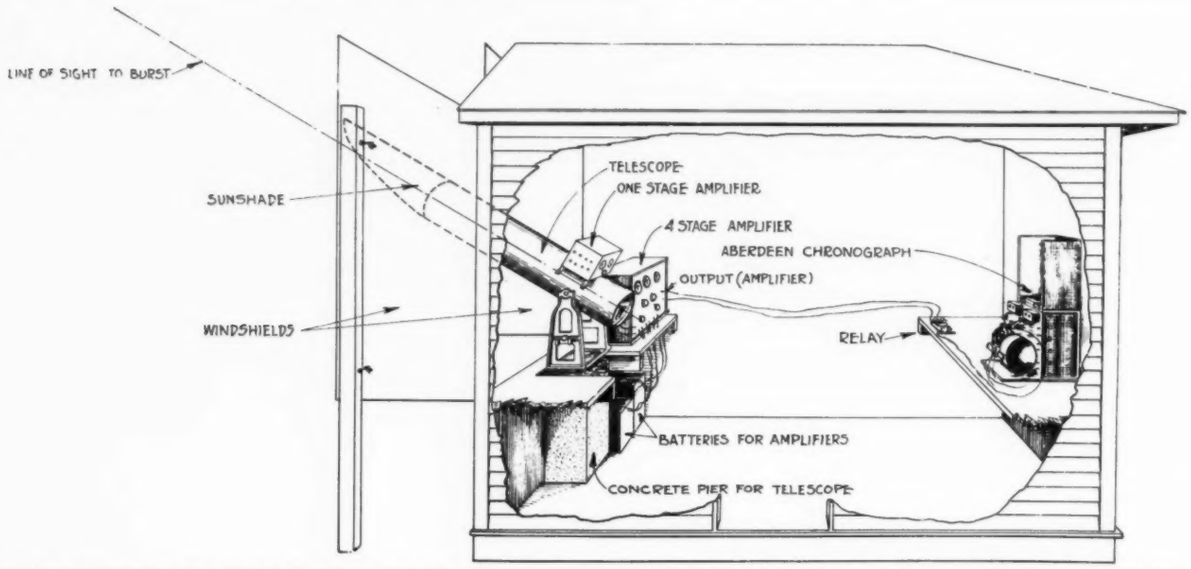
THROUGH numerous articles which have appeared in ARMY ORDNANCE in the past, the members of the Army Ordnance Association and the readers of this Journal are familiar in a general way with the purpose of the Aberdeen Proving Ground, its functions in relation to other Army activities and the part it plays in preparation for and in the actual defense of the Nation. In addition, many detailed descriptions have appeared of special apparatus and technical investigations undertaken at Aberdeen. For these reasons this article will be limited to a brief outline of relatively new developments in equipment and apparatus employed at the proving ground, of the investigations under way in ballistic and other lines of research and a short description of the latest types of ordnance matériel which have been tested during the past year.

Spark Photograph of Combination Recoil Check, Flash Hider and Sound Reducer T1 for Browning Automatic Rifle, Caliber .30, Model 1918.

In the province of exterior ballistics the actual resistance functions of a number of projectiles have been determined with what is believed to be a high degree of accuracy. The projectiles for which the resistance functions have been determined are the 75-mm. shell, Mark IV, which has a moderately long point and a boat-tail, the 3-inch common steel, antiaircraft shell, Mark IX, armed with the Mark III fuze, which has a blunt point and a flat base, and the 3-inch common steel shell, Model 1915, which has a long point and a flat base. These three types may be considered fairly representative. The purpose of obtaining these resistance functions is to enable the Ballistic Section to base its calculations of the effect of variations in wind, muzzle velocity and air density upon an accurate knowledge of the actual air resistance which the projectile encounters. These, as well as other experiments, have indicated that each projectile has a resistance function, which, in general, differs considerably from those of other projectile shapes but that there is little variation of resistance in a given shape because of size. If the greatest accuracy is to be obtained in the construction of the tables showing the effect of abnormal conditions on the range, it is essential that these tables be based upon the knowledge of the particular projectile in question. There is reason to believe that with tables constructed in this manner the accuracy and speed in the adjustment of fire which may be obtained will be decidedly superior to that which was possible before these resistance data were obtained experimentally.

In the field of exterior ballistics of small arms bullets

*Commanding Officer, Aberdeen Proving Ground, Maryland. Lieutenant Colonel, Ordnance Department, U. S. Army.



Apparatus Utilizing the Photo Electric Cell and Vacuum Tube Used to Obtain an Automatic Record of the Time of Flight of Antiaircraft Projectiles.

a spark photographic outfit which operates very successfully has been constructed and a considerable number of photographs have been taken with it. A closed range for the purpose of obtaining a series of spark photographs at different points along the trajectory of a given bullet and of measuring the retardation by photo-electric cells has been constructed and is now being equipped. When these facilities are put into operation it is expected that it will be possible to obtain resistance functions with small arms bullets with great accuracy and with relatively small expense. Thus it will be possible to augment our store of knowledge of projectile aerodynamics more rapidly than has been possible hitherto.

IN the field of interior ballistics a considerable number of records have been obtained with the Piezo-electric gauge of pressure as a function of the time when powder is burnt in a closed chamber. The object of these tests is to provide information of a fundamental nature for interior ballistic purposes. During these investigations measurements have been obtained of the rate of burning of powder as depending upon chemical composition, pressure, and grain form, of the co-volume of the molecules, and the ratio of the specific heats. While much work has already been done on this subject the results to date are not entirely satisfactory. It is hoped and expected that in the near future sufficiently accurate measurements of these quantities may be obtained to serve as a basis for more accurate tables of interior ballistics.

One of the interesting results of the application of the Piezo-electric gauge to the recording of pressure in guns is that it has been found, surprisingly enough, that pressure surges not infrequently occur in the chambers of guns when they are being fired. Although it was demonstrated some years ago by Vieille that it was possible to produce pressure surges by the burning of powder in a slender closed chamber, yet until the measurements at Aberdeen Proving Ground were made with the Piezo-electric gauge, the occurrence of these pressure surges in ordinary guns had not been suspected. By painstaking investigation of many powder chambers of different shapes and relative dimensions, it seems practicable to accumulate sufficient data to permit a powder chamber to be designed with the certainty that surging and erratic behavior having its origin in the shape of the chamber will not occur and to predict which of existing powder chambers will be free of surges and which others are apt to develop dangerously high erratic pressures due to this cause.

As a result of the continued application of the Piezo-electric gauge in making the measurements referred to, a considerable improvement in the technique of the recording has been obtained with the result that it is now possible to

The Browning Automatic Rifle, Caliber .30, as a Machine Gun.

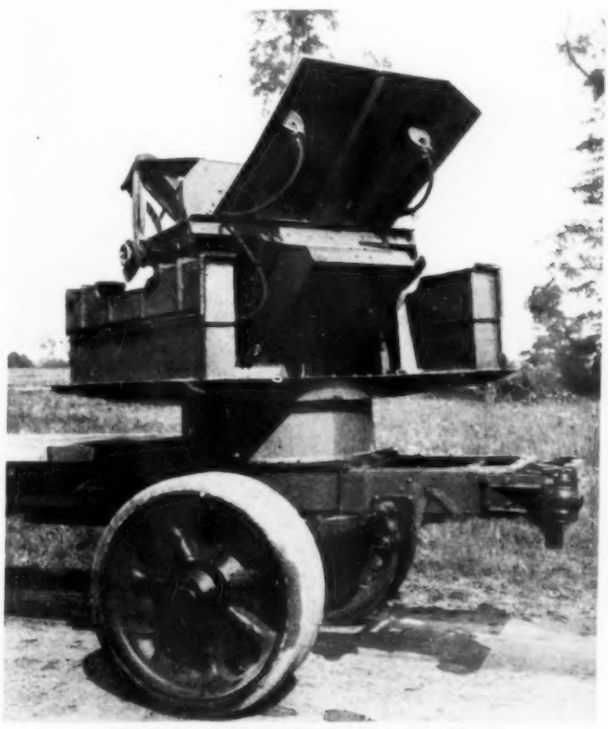
record the pressure surges in a chamber as short as that of the Springfield rifle.

While the copper crusher cylinder is still used and probably will continue to be used for the measurement of pressures during routine powder tests, the Piezo-electric gauge has been employed to obtain a calibration of the results given by the crusher cylinders. It has been found that the actual pressures as measured in guns are considerably higher than the pressure as measured by the crusher cylinders, the error of the crusher cylinder, of course, depending upon the size of the gun and the quickness of the powder, etc.

The Mobile Multiple Machine Gun Mount.

Among the instruments which recently have found wide application for ballistic purpose, none is more important than the photo-electric cell and the vacuum tube. The photo-electric cell, together with a powerful amplifier, has been made to serve as an instrument for obtaining an automatic record of the time of flight of antiaircraft projectiles. The amplifier in this apparatus is so arranged that it causes a spark to perforate a piece of paper which is carried on the drum of a slot-motion Aberdeen chronograph. When the gun is fired, the light, due to the muzzle flash, causes the first spark to jump and the burst of the projectile at a remote point of the trajectory causes the second spark. This apparatus has functioned satisfactorily for night firing but with less certainty for firing in the day time. To record the burst of a projectile in full daylight requires sensitivity of the highest degree that can be obtained.

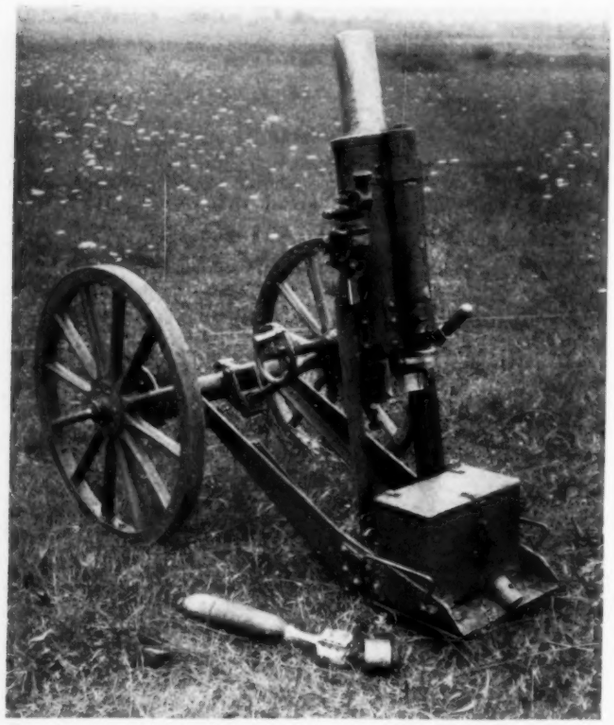
The photo-electric cell has also been applied to the measurement of velocity of projectiles. The apparatus is so constructed that when the projectile passes overhead a reduction in the light which impinges on the cell is recorded by means of an amplifier on an oscillograph or other instrument. This method of measuring velocities is especially suitable for the measurement of the velocity of large guns at angles of elevation too great for convenient use of the solenoid chronograph but preferably not in excess of 30° or 40°. For still higher angles of elevation the Jekaduma optical chronograph, a development made by Dr. Hans Duda, of Vienna, has been tested at the proving ground and found to give fairly accurate and satisfactory results. An interesting application of the photo-electric chronograph has been made in the measurement of the velocities of the machine gun bullets during a burst, a measurement which could not very well be made with any other type of existing chronograph. It was found in these measurements that the bullet velocities at the end of a 250-round machine gun burst do not differ appreciably from the bullet velocities at the beginning of the burst.



The Portable Multiple Machine Gun Mount.

TO obtain a record of the impact of inert bombs on the ground in connection with ballistic data and also to record the delay of bomb fuzes, a very sensitive apparatus—based upon the vacuum tube oscillating circuit—has been made. The ground shock from the impact of bombs, slight as it is, causes a change in the distance of two metal plates, the capacity between which forms part of the capacity of the oscillating circuit. When this capacity changes, the plate current of the vacuum tube changes. This change in the plate current is amplified by an audiofrequency amplifier which finally causes a record to be obtained by a motion of a pen on a chronograph drum. This apparatus has been found so sensitive that records have been obtained with it of the impact of 17-lb. bombs on rather soft ground at a distance of 1,200 feet from the apparatus. The impact of heavier bombs can be recorded with certainty at a distance of a mile or more from the station.

In addition to the application of the vacuum tube to new forms of chronographic apparatus, improvement has been made in the older forms of chronographs. The amplifier has been introduced as an aid in recording velocities by solenoids and the precision and reliability of the instrument has been considerably increased thereby. Simultaneous measurements of the



The 75-mm. Infantry Mortar, M1. The latest development in a weapon of this type.

velocity of small arms bullets by means of the photo-electric cell and the Aberdeen chronograph have shown that not infrequently velocities measured by the Aberdeen chronograph have been considerably in error. This occasional error was apparently due to a failure of the spark to jump at the very instant the screen was hit by the bullet. The discovery of this occasional error when using the Aberdeen chronograph has led to the adoption of new types of screens which give a higher degree of precision in the use of this chronograph for the measurement of the velocity of small arms bullets.

In general, accuracy of measurement is of fundamental importance in the work of the proving ground and every effort has been made to improve the accuracy of existing instruments and to secure or develop new instruments of precision.

EARLY in the progress of the development of flashless nonhygroscopic powder it became evident that ignition methods, heretofore used for nitrocellulose and double-base powders, were much less satisfactory for the new type of powder. Much firing has been done in accordance with a well considered experimental program furnished the proving ground by the Chief of Ordnance to determine the fundamental data in regard to conditions essential to the ignition of FNH powders to secure uniform interior ballistics and flashlessness without an objectional amount of smoke. At the present time firings are being limited to the 3-inch antiaircraft gun, Model 1917, with a view to a complete solution of the problem for this gun. It is believed that when this has been done conclusions as to the ignition necessary for any combination of chamber and bore may be drawn that will be substantially correct and will require little, if any, modification by experimental firings in any particular gun. It may be said that ignition completely satisfactory as to interior ballistics may be obtained in the 3-inch antiaircraft gun with a primer that is much larger than has been used for a nitrocellulose powder, but which does not suffice to give flashlessness with flashless powder of present composition. The increase in size of primer to give flashlessness does not impair the uniformity of interior ballistic results but increases the smoke. The smoke is objectionable for day firing and the flash is objectionable for night firing. Flashlessness may be obtained by adding a flash reducer. It seems possible, therefore, that the ultimate solution will be the use of a primer to give complete ignition and not excessive smoke with the provision of a small amount of flash reducer to be added to secure flashlessness at night.

THE most marked development in small arms since the World War is the high state of efficiency to which semiautomatic shoulder rifles have been brought experimentally. Until recently it has been believed impracticable to design a semiautomatic shoulder rifle firing a caliber .30 bullet at service velocity within a weight approximating that of the Springfield rifle, Model 1903. Accordingly extensive experiments were undertaken to determine the effectiveness at various ranges of a bullet of smaller caliber; namely, .276-inch. As a result of this experimental work the War Department directed a test of semiautomatic shoulder rifles of this caliber. This test was conducted during the summer of 1929, under the direction of a board of officers appointed by the Secretary of War. Seven rifles were submitted to the board and five were tested. Three of the five tested were of American design and manufacture and two were of foreign manufacture. Of the American rifles, two were designed and manufactured by the Ordnance Department at the Springfield Armory.

Tests have shown that a partially trained rifleman can obtain twice as many hits per minute, with a satisfactory semiautomatic rifle, as with a separate-loading rifle of the bolt type. It seems not too optimistic to say that in case of necessity production can be started at once on a satisfactory type of semiautomatic shoulder rifle and that at least four such exist in experimental form at this time.

The 75-mm. Infantry Mortar, M1.

THE removable liner represents a marked advance in gun construction. Until its advent, when the accuracy life of a cannon was reached, it was necessary to return the gun to an arsenal or gun factory for relining. In war this had the effect of removing the gun from the front for a long period at a time that might be critical. In peace or war it is expensive and causes long delay. Removable liners have now been made and have been used successfully in 3-inch and 105-mm. antiaircraft guns. One 3-inch gun, with removable liner, has been fired 2,800 rounds and is still serviceable and reasonably accurate. The earlier liners were so designed as to require close manufacturing tolerances and were not interchangeable. During the Antiaircraft Exercises of 1929 at the proving ground a type of removable liner, with increased manufacturing tolerances and additional clearance between liner and tube, was tested. The thickness of the liner is greater than that of the earlier type and, consequently, it is heavier to handle. Its weight, however, is still such that it can be removed in the field by six men and the only necessary tool is a retaining ring spanner wrench. There seems no engineering reason why the use of removable liners cannot be extended to guns of greater caliber.

The 75-mm. Infantry Mortar Broken Down for Transportation into Five One-Man Loads.

THE T1 Multiple Machine Gun Mount, designed primarily for antiaircraft fire, is composed of a truck chassis carrying a pedestal-mounted platform upon which are mounted four caliber .50 machine guns with fire-control instruments. The chassis is of 5½ tons capacity of a standard make with a 4-wheel driving bogie of great flexibility. This makes of it normally a 6-wheel vehicle, each wheel carrying two pneumatic tires. The front, or steering, wheels carry tires of different diameter, the outer ones smaller by two inches than the inner ones, so that on firm ground only one tire of each front wheel is in bearing, but on soft ground where the penetration of the larger tire is two inches, the smaller tires come into bearing and add to the flotation. An added and unique feature is that the two spare wheels with tires are mounted on free turning idler shafts, one on each side of the driver's cab and so positioned that they bear on obstructions over which the truck is traveling rather than permit the underside of the chassis to strike such obstructions. The firing platform mounted on a pedestal just forward of the rear driving wheels has a traverse of 360° about the pedestal. Upon this platform the gun cradle is mounted with four caliber .50 water-cooled machine guns, a 3-meter stereoscopic height finder and a modified Vickers data computer. Four guns are so mounted in the cradle that their axes are parallel and co-planar and all are aimed together. The ammunition in links is carried in boxes immediately under each gun and fed to the gun through chutes, the feeding mechanisms being operated by the recoil of the gun. A reserve supply of ammunition is carried strapped on the chassis of the truck. Lateral deflection is accomplished by movement of the entire platform and elevation by tipping the gun cradle to the desired angle. Aiming of the guns is accomplished by a 3-meter stereoscopic finder. Predictions of the future position of the moving target are made automatically and directly to the guns through the data computer which operates constantly through differential gearing to the shafts connected with the steroscopic finder. The total operating crew, including drivers, is 15. This truck is fast and its speed is indicated by the fact that it averaged 24 miles an hour from Watertown Arsenal to the Astor Hotel in New York City. Its large tire surface gives it excellent flotation, and tracks for attachment to the wheels of the driving bogie enable it to negotiate almost any cross-country terrain. Tests already made indicate that as at present mounted, the fire-control instruments and the guns must be coördinated after 200 or 300 miles of rough cross-country use. The test has not yet been completed.

The T2 Multiple Machine Gun Mount, recently received and not yet tested, carries two caliber .50 guns in a structure suitable for mounting on any good 1½-ton truck chassis, and the total crew required for operation, including the driver, is but 3 men. The mount consists primarily of a pedestal and base ring. The latter is suitable for attachment to a truck chassis or even to the bottom of a truck body. A cradle slung on the pedestal carries the two guns, gunner's seat and fire-control instruments, thus traversing and elevating these parts in unison. It is worthy of note that the position of the gunner, relative to the guns, is not changed as they are moved in elevation and azimuth. The guns are about 30 inches apart and the gunner's seat

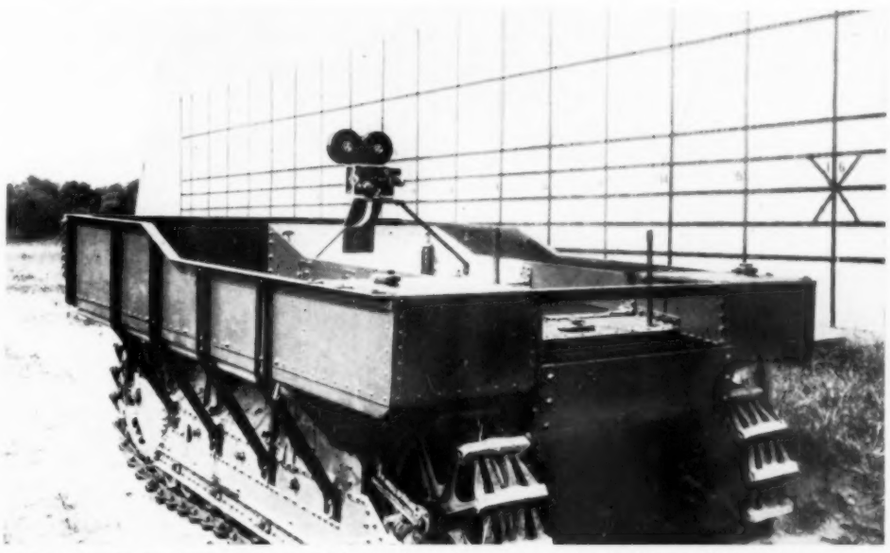
The 155-mm. Howitzer, T1, which Fires a 95-lb. Projectile 16,390 Yards.

is between them. Immediately in front of the gunner and at a convenient height are located the fire-control instruments rigidly fixed in relation to the guns. These consist of an open sight by means of which the target is sighted and a 1-meter base stereoscopic finder through which the gunner observes the relative position of the target and the tracer bullets being fired. All of the ammunition linked together is carried in convenient boxes for each gun. The total ammunition carried is 1,200 rounds per gun. The mount has a traverse of 360° and the guns can be elevated from 0° to 89°. Traverse is accomplished by means of a crank convenient to the left hand of the gunner and elevation by means of a crank convenient to the right hand of the gunner. He fires with his foot. As compared to the T1 Multiple Mount, the T2 seems simple, rugged and economical of man power.

THE 75-mm. Infantry Mortar M1 is the latest development in an infantry mortar weapon. It is a smooth bore and fires a vaned projectile weighing approximately 10⅝ lbs. to a maximum range of about 2,000 yards. The carriage permits a traverse of 13° without moving the trail and a maximum elevation of 80°. The weapon in firing position weighs 362 lbs. and its total weight, including accessories, is 422 lbs. It breaks down for transportation into five one-man loads, the heaviest of which is 94 lbs., for transportation. The ammunition for this weapon has not yet been standardized, but will probably be a shell equipped with cast aluminum or steel fins with longitudinal vanes. Ignition is obtained with a shot gun shell and different zone charges are made by added increments of powder inserted between the vanes. It has a short brass cartridge case which will probably be screwed to the fins by crimping. This weapon has great accuracy and greater range than the Stokes mortar used in the World War, but due to the breech loading, it has much less volume of fire. Rapidity of fire and retention of range and accuracy could be obtained by adopting the Stokes mortar method of loading. The objection to [illegible], of course, is the possibility of an accident in striving for rapidity of fire in the heat of action.

The 155-mm. Howitzer T1 was designed as a companion piece to the 4.7-inch gun for use in the corps artillery. It was designed to fire a 95-lb. projectile to a range of 16,390 yards. Recent tests, however, have indicated that a range of over 18,800 yds. can be obtained with a muzzle velocity of 1950 f. s. without exceeding conservatively safe pressure. The carriage is of the split-trail type and permits an elevation of 60° with a traverse of 55° without moving the trail. The outstanding features of this carriage are the great elevation permissible, the fixed length of recoil, the addition of equilibrators, the type of suspension of the bottom carriage on the axle, and the quick return from high elevations to near horizontal for loading. The carriage has been found quite stable in firing at all elevations and deflections. The total weight in firing position is approximately 14,000 lbs. and the aggregate road weight is 16,500 lbs. It is of interest to compare this weapon with the 155-mm. gun, Model 1918 (G. P. F.), which weighs in firing position approximately 26,000 lbs. and fires a 95-lb. projectile to a maximum range of but 17,460 yards. While the range of this weapon is 6,000 yds. less than the range of the latest 155-mm. gun, its demonstrated range and flexibility raises a question of

the necessity of including in the corps armament the most modern 155-mm. gun. The place of the 155-mm. gun, Model 1918 (G. P. F.), can undoubtedly be taken by the T1 Howitzer.



Tank Chassis Equipped with a High-speed Motion Camera to Test its Suitability as a Moving Gun Platform.

THE growing importance of aircraft as an offensive weapon creates requirements not only for protection from air attack on industrial centers and important installations, military and civilian, but troops on the march and in combat must now be protected from the harrassing of fast, low-flying planes; in fact, it appears that the time is rapidly approaching when a weapon that does not provide for high angles of elevation and fire-control methods to make it effective against air targets must be considered at least obsolescent. Readers of ARMY ORDNANCE are already familiar with development of the 3-inch mobile anti-aircraft guns and the use of caliber .50 machine guns for this purpose. To adapt the latest type of .75-mm. field gun to attack of air targets, two carriages known as the 75-mm. T2 and the 75-mm. T3 have been designed and the pilots have been built and given a preliminary test. The T3 carriage has been fully described in an article in the May-June, 1930, issue of this Journal. The 75-mm. T2 carriage, designed and built at the same time, is, in general, similar and its purposes are identical with the T3 carriage. In fact, it mounts the same gun, cradle and recuperator system and its total weight is within a few hundred pounds of the weight of the T3 carriage. Like the T3 carriage it is equipped with high speed bearings, but each wheel carries only one balloon tire instead of two.

The pedestal is of the built-up type of construction and contains a lifting jack and spade. By means of a release-fall the spade is lowered to the ground and on this base the pedestal is jacked up until the wheels can then be removed. The pedestal is then tripped, drops to the ground, and the carriage is ready to fire. It is provided with three outriggers and with all of them in use it has all-round fire at an angle of elevation up to 80°. It can be fired with but two outriggers, in which case it has a traverse of approximately 100° at the same elevation. This carriage has no cross-leveling device but sights are now being constructed which will remedy this deficiency. (Editor's Note: The T2 Mount was more fully described in an article by Capt. E. C. Goebert, "Modern Thought in Division Artillery," in the July-August, 1930, issue of ARMY ORDNANCE.) The test of this carriage as well as that of the T3 indicates that they are both satisfactory for the purposes for which designed.

The Machine Gun Camera Mounted on a Light Tank for the Determination of Gun Platform Characteristics.

SINCE the World War a wide variety of automotive equipment, including tractors, tanks, self-propelled mounts and trucks, suitable for prime movers for guns, have been tested at the Aberdeen Proving Ground. Based on the experience and data gained in these tests, the Chief of Ordnance has approved a rather complete program for testing light tanks and a similar one for testing medium tanks. These programs are sufficiently extensive to develop quite fully the desirable features as well as the weaknesses and deficiencies of the tanks tested, and it is believed they subject a tank to practically any condition under which it will be called upon to operate in actual service, except being fired upon while in motion.

The Light Tank Undergoing Tests at the Aberdeen Proving Ground.

An important characteristic of a tank is its suitability as a moving gun platform. This test was first made by running various tanks over a predetermined course at various speeds and having the gunner fire at a fixed target, the relative stability as gun platforms being indicated by the number of hits on the target made by the same gunner on different tanks. This method of testing was not entirely successful because of the inclusion in the results of the human equation of the gunner. The second method used, which was more successful, was to mount a high-speed motion picture camera as a gun on each vehicle and taking with it moving pictures of a grid system painted on a side of a building. By measuring and analyzing these pictures the component of vertical acceleration was determined and the tanks were rated on the assumption that vertical acceleration and deceleration are inverse indices of the suitability of a platform as a gun mount. In addition to this information, basic data needed for determining the dynamic forces to which parts of a tank are subjected were obtained.

The next method used was to mount a type T1 machine gun camera in back of the machine gun. This camera is operated by the machine gun trigger, uses motion picture films, and takes six pictures per second while the trigger is being pulled. By tabulating and averaging the hits and misses made on the same runs with different tanks, excellent comparative results, including the human factor, were obtained. In general, the results confirmed the assumption previously made, i. e., that the smaller the vertical accelerations the better the gun platforms. This method of testing has indicated that the machine gun camera is an excellent and inexpensive method for teaching tank gunnery.

In the light tank field the link-type track suspension has been thoroughly tested and designed to have an operating life far greater than that of any other light tank track suspension yet tested. A spring hydraulic type of suspension has been partially tested and is considered very promising. A horizontal leaf spring track suspension is now undergoing test on a 5-ton vehicle. A program for the test of a medium weight Christie tank has been received and the test will be started as soon as the tank is delivered.

The Medium Tank During a Proving Ground Test.

THE TWELFTH ANNUAL MEETING

OF THE

ARMY ORDNANCE ASSOCIATION

The Committee on National Defense, U. S. Chamber of Commerce, participating

WILL BE HELD

WEDNESDAY AND THURSDAY, OCTOBER 8th and 9th, 1930

The business and technical session for the discussion of munitions development and the transaction of Association business will be held in the Auditorium of the U. S. Chamber of Commerce Building, Washington, D. C., Wednesday, October 8th, at 8:15 P. M.

The engineering and scientific session for the observation and study of current tests of ordnance and other Army equipment will be held, with the approval of the Secretary of War, at the Aberdeen Proving Ground, Maryland, Thursday, October 9th, beginning at 10 A. M.

Tentative programs and general information on the following pages.

TENTATIVE PROGRAMS

OF THE SESSIONS OF THE

TWELFTH ANNUAL MEETING, ARMY ORDNANCE ASSOCIATION

Wednesday, October 8, 1930, 8:15 P. M.

Auditorium, U. S. Chamber of Commerce Building, Washington, D. C.

Business and Technical Session

(Detailed program will be distributed at the meeting)

Presiding Officer: Hon. Benedict Crowell, President, Army Ordnance Association.
Address: Hon. Frederick H. Payne, The Assistant Secretary of War.
Address: Maj. Gen. Samuel Hof, Chief of Ordnance, U. S. Army.
Address: Mr. Ernest T. Trigg, Chairman, Committee on National Defense, United States Chamber of Commerce.
Technical Illustrated Address: Brig. Gen. Wm. H. Tschappat, Assistant to the Chief of Ordnance, U. S. Army.
Address: Brig. Gen. Edwin D. Bricker, Assistant to the Chief of Ordnance.

Committee Reports:

Announcement of Election of Officers for terms beginning January 1, 1931.
By Mr. A. Y. Leech, Chairman, Committee of Tellers of Election.

Foundation and First Award of the Williams Gold Medal for Distinguished Ordnance Service:

This medal, founded by the Army Ordnance Association in honor of Maj. Gen. C. C. Williams, former Chief of Ordnance, will be awarded by direction of the Board of Award to General Williams.

Reception Committee, Washington Post, Army Ordnance Association.

Thursday, October 9, 1930, 10 A. M.

Aberdeen Proving Ground, Maryland

Engineering and Scientific Session to Witness Current Tests of Ordnance and Other Army Equipment

(Detailed program will be distributed at the meeting)

9:30 A. M. — Arrive Aberdeen Proving Ground.
10:00 A. M. — Main Front. Opening Exercises.
10:10 A. M. — Main Front. Gun Testing Division Firings.
11:00 A. M. — Main Front. Demonstration of Automotive Equipment.
12:00 M. — Dinner.
1:00 P. M. — Main Front. Air Corps Demonstration.
2:45 P. M. — Seacoast Range. Current Tests of Antiaircraft Artillery.
3:45 P. M. — Seacoast Range. Current Tests of Seacoast Artillery.
4:25 P. M. — Aviation Field. Exhibition of Army Aircraft.
5:00 P. M. — Supper.
6:15 P. M. — Antiaircraft Range. Antiaircraft Artillery Night Firing Tests.

GENERAL ANNOUNCEMENTS

ADMISSION

Admission to both the Washington and Aberdeen sessions of the Twelfth Annual Meeting will be restricted to members of the Army Ordnance Association and their guests and the members of the Committee on National Defense, United States Chamber of Commerce, and will be by ticket. All members have been furnished tickets which will admit them: 1. To the business and technical session at Washington, October 8th; 2. To the Aberdeen Proving Ground, October 9th; 3. To a reserved section on the Main Front to witness all tests at that point.

Due to the limited facilities and the increasingly great crowds which have attended the meeting in former years, these restrictions have become neceessary. Ladies will not be admitted to either session.

REDUCED RAILROAD FARE

Members of the Army Ordnance Association and of the Committee on National Defense, U. S. Chamber of Commerce, can travel to both the Washington and Aberdeen sessions, or to either, at reduced fare by presenting an Identification Certificate to the local railroad ticket agent at practically any point in the United States. Members from northern and eastern points attending the Washington seession may purchase a round-trip ticket to Washington with stop-over at Aberdeen, Maryland, on return. Members from western and southern points attending the Washington session may purchase a round-trip ticket to Aberdeen with stop-over at Washington, D. C. Certificates, with invitation and other data, have been sent to members of the Army Ordnance Association and the participating organization. A round-trip ticket using the Identification Certificate may be purchased at one and one-half times the one-way fare.

SPECIAL TRAINS

A special train of Pullman sleeping cars open for occupancy at 10 P. M., October 8, will leave Pennsylvania Station, New York City, shortly after midnight, October 8-9, arriving at Aberdeen Proving Ground for breakfast. Returning, this special train will leave the Proving Ground after the night demonstrations and will arrive in New York in time to make midnight connections for other points. Maj. P. R. Faymonville, Secretary, New York Post, Army Ordnance Association, 39 Whitehall Street, New York City, will purchase accommodations for those who desire to travel on this train.

Arrangements are contemplated for operating special cars from Springfield, Mass., and intermediate Massachusetts and Connecticut cities and from Cleveland, Ohio, and a special train from Pittsburgh, Pa., for the Aberdeen Meeting. Complete details regarding these projected special facilities may be obtained, respectively, from Maj. J. K. Clement, Executive Assistant, Bridgeport District Ordnance Office, Springfield Armory, Springfield, Mass.; Maj. W. A. Borden, Executive Assistant, Cleveland District Ordnance Office, 1524 Keith Bldg., Cleveland, Ohio; or Capt. F. A. McMahon, Secretary, Pittsburgh Post, Army Ordnance Association, 1014 Diamond Bank Bldg., Pittsburgh, Pa.

MEALS

At the Aberdeen Proving Ground, Thursday, October 9, meals will be served by caterer. For those traveling by special trains arriving at the Proving Ground in the early morning, breakfast a la carte will be served for which no advance reservation need be made.

A course dinner (noon) and supper (5 P. M.) will be served by caterer only to those who have made advance reservations with the Commanding Officer, Aberdeen Proving Ground. All members have been furnished notices and reservation forms for this purpose. Due to the limited facilities at the Proving Ground the caterer will not be able to accommodate more than 800 for served meals. Reservations will be accepted up to this number. Members who do not make advance reservations, or whose orders are received after reservations are closed, may procure light luncheon (sandwiches, coffee, etc.) up to the limited capacity of the Post Exchange and concessionaires. No provision will be made for serving box lunches as in former years.

Reservations for caterer's meals must be received by the Commanding Officer, Aberdeen Proving Ground, not later than Monday, October 6th. The cost of the course dinner will be $2.25 and supper $1.75, checks payable to the Commanding Officer, Aberdeen Proving Ground, to accompany reservation.

All members are urged to be present at both sessions of the Twelfth Annual Meeting. The distinguished speakers who will address the business and technical session in Washington on October 8 and the importance of their messages warrants a full attendance. Members who are not able to attend the Washington session may travel direct to the Aberdeen Proving Ground for the engineering and scientific session on Thursday, October 9, where a complete program of current tests and demonstrations of latest Army equipment, participated in by nearly all branches of the Army, will maintain the traditional and important significance of "The Aberdeen Meeting."

The following regular trains as numbered will stop at Aberdeen, Md., Thursday, October 9. Consult latest time table for possible minor changes in time. Time shown is Eastern Standard.

GOING

Southbound—	Pennsylvania Train No. 403	Baltimore and Ohio Train No. 15
Leave Philadelphia:		
Broad Street	7:20 A.M.	———
West Philadelphia	7:25 A.M.	———
Wayne Junction	———	7:32 A.M.
24th and Chestnut	———	7:50 A.M.
Leave Wilmington	8:05 A.M.	8:26 A.M.
Arrive Aberdeen	8:49 A.M.	9:17 A.M.

Northbound—	Train No. 124	Train No. 518
Leave Washington	7:25 A.M.	7:35 A.M.
Leave Baltimore:		
Union Station	8:24 A.M.	———
Camden Station	———	8:23 A.M.
Mt. Royal Station	———	8:29 A.M.
Arrive Aberdeen	8:59 A.M.	9:08 A.M.

RETURNING

Northbound—	Pennsylvania Train No. 158	Baltimore and Ohio Train No. 28
Leave Aberdeen	8:30 P.M.	8:33 P.M.
Arrive Wilmington	9:31 P.M.	9:20 P.M.
Arrive Philadelphia:		
West Philadelphia	10:06 P.M.	———
Broad Street	10:11 P.M.	———
24th and Chestnut	———	9:55 P.M.
Arrive New York	12:25 A.M.	———

Southbound—	Train No. 133	Train No. 9
Leave Aberdeen	8:25 P.M.	8:10 P.M.
Arrive Baltimore:		
Mt. Royal Station	———	8:56 P.M.
Camden Station	———	9:01 P.M.
Union Station	9:01 P.M.	———
Arrive Washington	10:00 P.M.	9:50 P.M.

Industry and The National Defense

The Preparedness Role of the U. S. Chamber of Commerce

By Ernest T. Trigg*

"RECOGNIZING the military obligation equally with the civic obligation as a fundamental duty of democratic citizenship in the republic," the Chamber of Commerce of the United States as early as 1916 went on record as an advocate of preparedness and adequate national defense. In those feverish days of uncertainty and confusion, when a World War raged outside our boundaries and threatened to force us into the conflict, the National Chamber called for an increase in America's traditionally small land and sea forces, for a Council of National Defense, a staff of Industrial Mobilization, and a coördination of industrial resources "to make fully available the military, industrial and financial strength of the nation." It emphasized the importance of a continuing policy of national defense which should provide not only for the exigencies of the war then threatening—and which a year later engulfed the United States—but for adequate preparedness for any future emergencies.

In the light of future developments there is particular interest attached to the April, 1916, declaration of the membership of the National Chamber. "Recognizing that the constituent elements of necessary war material," it read, "are of such infinite variety that they cannot be produced in Government plants in time of war but are and must be produced in highly diversified and specialized industries, a fundamental feature of national policy for supplying war material should be to educate private industry in time of peace in the manufacture of such material, under prearranged Government regulation of prices, rather than to trust to protection in Government plants alone. Educative arrangements with manufacturers for the production of war material in time of peace serve not only to supply current needs of the Army and Navy but also to accumulate a reserve of war materials sufficient to supply our land and sea forces, both regular and reserve, from the beginning of a possible war until such time as the industries of the country can produce the increased supplies then requisite."

Thus it was that this organization a year before America entered the World War called for an adequate national defense and proposed not only preparedness in man power but in the equally important factor of munition power.

WHAT is this Chamber of Commerce of the United States? What does it represent? Did it in 1916—and does it in 1930—voice the opinion of just a few or of many American business citizens on such pressing problems as that of national defense? What weight has its opinion? Has this organization, since the World War, continued its advocacy of a patriotism which goes far beyond that which is only vocal on Fourth of July, a patriotism rather which is foresighted, intelligent and truly patriotic in the highest sense?

First a word as to the make-up of the Chamber of Commerce of the United States. There is a story in its origin.

At the beginning of the present century, and even before, there was an appreciation of the need of definite contact between government and business—some medium, some organization to voice a consensus of national business opinion. This was recognized by the President of the United States, Mr. William H. Taft, in 1911, when he took the initiative and invited the aid of American business men. "I want your assistance," said President Taft, "in reference to these matters that affect the business and the business welfare of this country." It appeared obvious, said the President, that a national clearing house of business opinion through which American industry and commerce, in all its phases, could express its collective views and judgment, "must be instrumental in a very large field to aid and assist the executive and legislative branches of government."

Pursuant to this invitation of President Taft five hundred business men, representing business men's organizations, chambers of commerce, and trade associations, met in Washington in 1912 and conceived an organization—The Chamber of Commerce of the United States—which would be representative of all the business interests of the nation and which would broaden the varied opinions of all sections and all industry into the collective and united voice of business America.

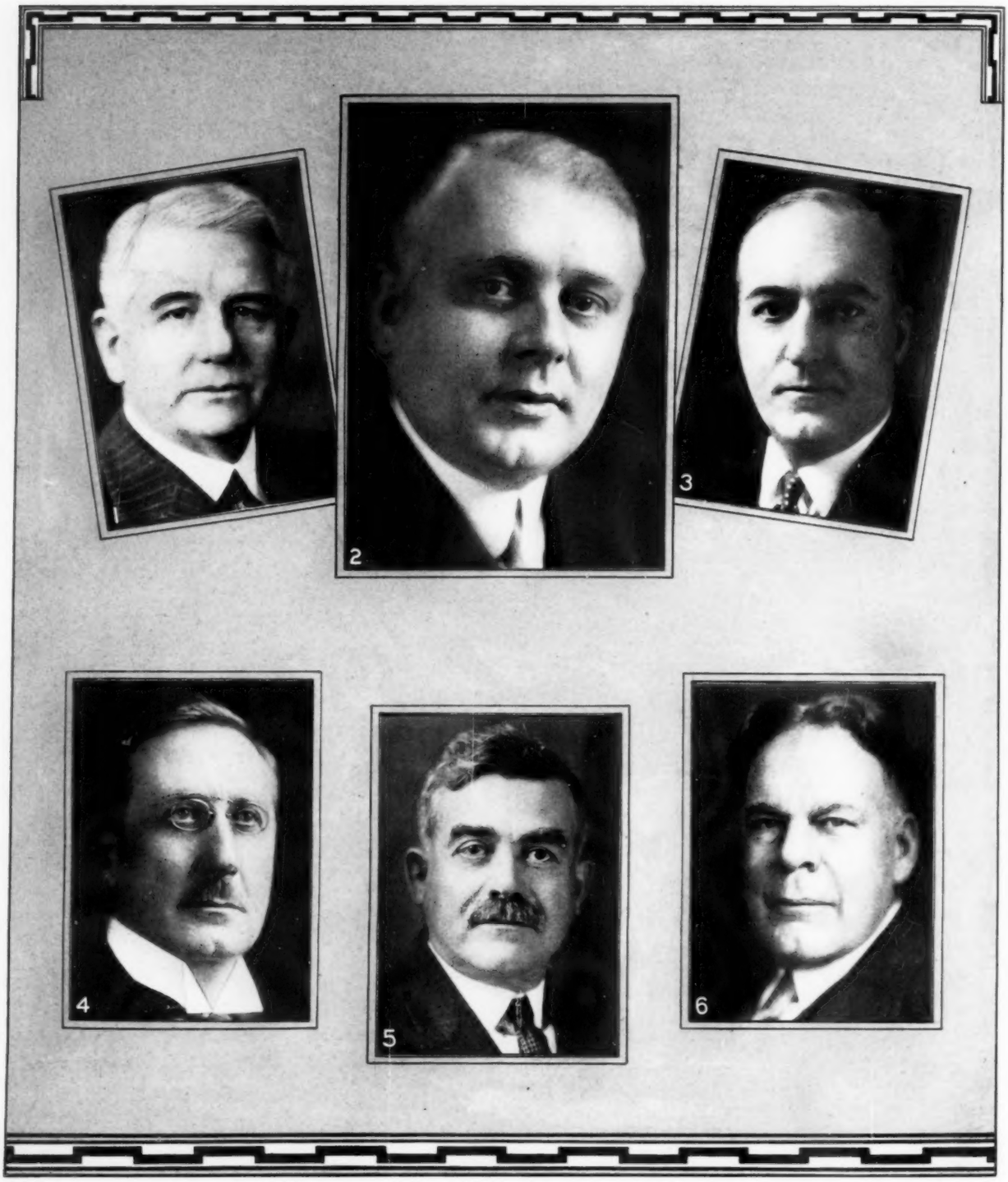
The founders of the National Chamber were determined that the organization should not only be national in scope, that it should collect and clarify the opinions of business men in each phase of industry and from local communities scattered throughout the nation and then present the consensus of those opinions as the united judgment of business America, but that the organization should be democratic in character. Power and jurisdiction were vested in the individual member organizations. An administrative establishment was organized which, at all times, should be directly responsive to the membership. Voting power was granted to business organizations which were representative in a character corresponding to their ideas of the founders and which, in their entirety, embraced the broad panorama of American business.

Thus the Chamber of Commerce of the United States came into existence at the invitation of President Taft to present to government and to public the authentic opinion of all business on questions of national policy. How well the founders laid the basic principles of the organization is revealed by President Wilson's comment, in 1914, that the National Chamber was particularly useful to government because it obtained "a sort of consensus of opinion which proceeds from no particular quarter and originates with no particular interest." It presented a national business opinion truly national and representative.

On the anvil of the National Chamber, the headquarters of which are in Washington, national business opinion is forged by its members, who represent over 1,800 business men's organizations which in themselves represent com-

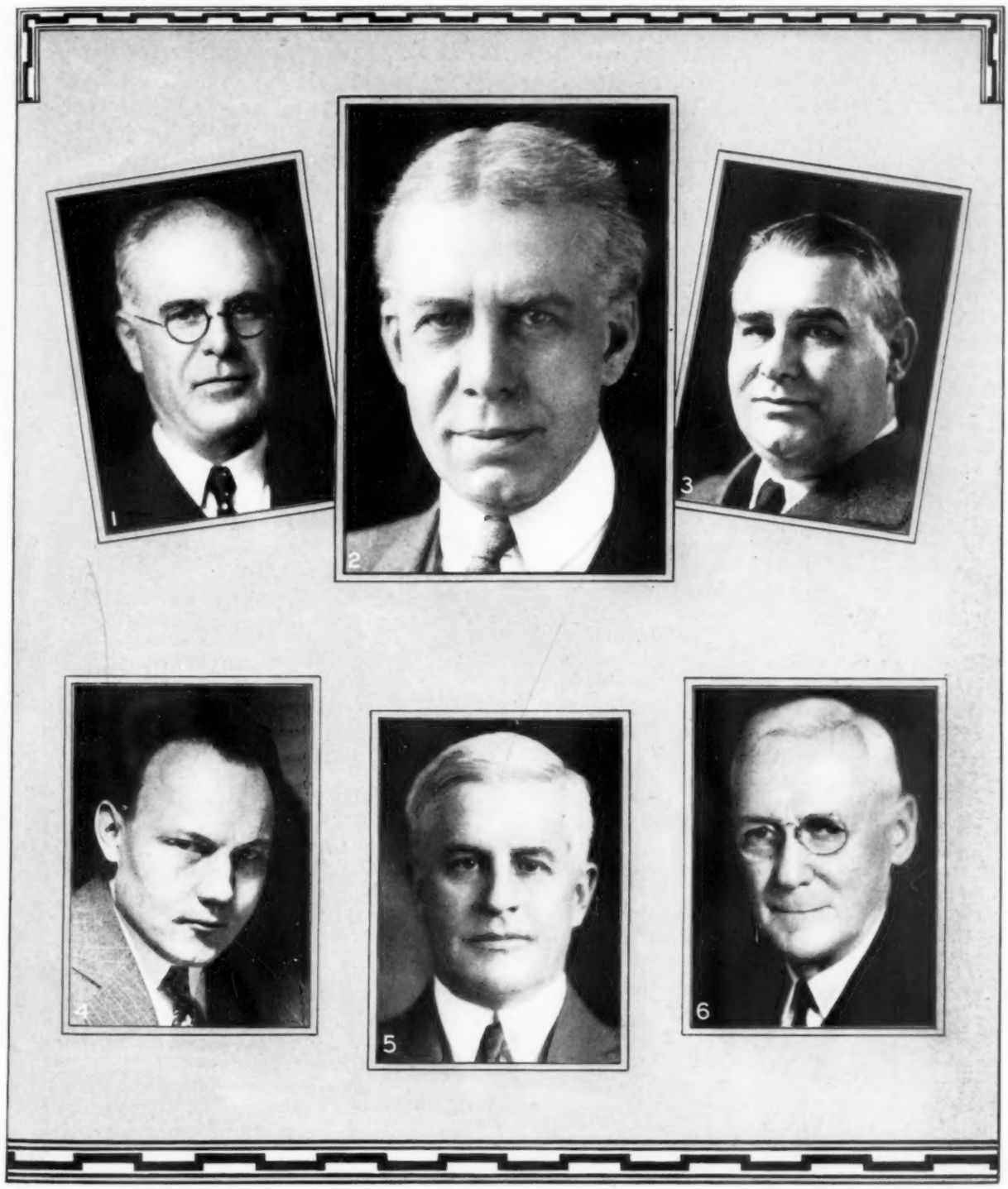
*Chairman, Committee on National Defense, Chamber of Commerce of the United States.

Committee on National Defense, United States Chamber of Commerce



1. Carl R. Gray, President, Union Pacific System, Omaha, Neb. 2. Ernest T. Trigg, Chairman of the Committee, President, John Lucas & Co., Inc., Philadelphia, Pa. 3. Col. Noble Brandon Judah; Judah, Reichmann and Trumbull, Chicago, Ill. 4. R. G. Rhett, President, Peoples State Bank of South Carolina, Charleston, S. C. 5. A. J. Brosseau, President, Mack Trucks, Inc., New York, N. Y. 6. E. Kent Hubbard, President, Manufacturers Association of Connecticut, Hartford, Conn.

Committee on National Defense, United States Chamber of Commerce



1. C. W. Davis, President, Dallas Power and Light Co., Dallas, Texas. 2. Frederick J. Haynes, Vice Chairman of the Committee, President, Durant Motors, Inc., Detroit, Mich. 3. Bascom Little, President, Crowell and Little Construction Company, Cleveland, Ohio. 4. F. Stuart Fitzpatrick, Secretary of the Committee, Manager, Civic Development Department, U. S. Chamber of Commerce. 5. Henry D. Sharpe, President, Brown and Sharpe Manufacturing Co., Providence, R. I. 6. W. L. Clause, Chairman of the Board, Pittsburgh Plate Glass Co., Pittsburgh, Pa.

munities from Eastport, Maine, to San Diego, from Seattle to Tallahassee. Resolutions adopted in annual meetings held in Washington by accredited delegates of these member organizations voice the views of business men everywhere. Intimate and direct contact with the central organization in Washington is maintained by national councillors who bring into the national forum the views of their particular sections and industries and return to their local chambers and trade associations with the points of view of industry and commerce throughout the nation as crystallized through the National Chamber. Furthermore, the referenda process plays a significant part in Chamber activities. Through this process national questions are submitted to each federated member organization for its judgment, after the subject has been thoroughly investigated in all its aspects by a special committee of the National Chamber composed of volunteer business men of recognized business leadership, men eminent in all phases of business activity, who freely give their time, their counsel, their experience, and judgment in order to vitalize and make effective the purposes of the National Chamber. And so it is that when the Chamber of Commerce of the United States speaks, it speaks as the instructed spokesman of the business men who are its members.

That opinion is impressive because facts are impressive—facts which have been gathered and analyzed and agreed upon by business organizations throughout the nation. Such definite and clear-cut expressions of the matured judgment of the national business community bear their own credentials. They have been of recognized assistance in the formation of such national legislation as the Federal Reserve Act, the Federal Budget System, the Transportation Act of 1920, Flood Control, and various tax reform measures. These are typical of many. The significance is this: Chamber of Commerce statements, representing business views as expressed through reports of special committees, and the resolutions and referenda of member organizations, have been given thoughtful consideration by both government and public.

WHAT has this organization done about national defense? Has it, now that the World War is a decade past, fallen into the all too general apathy which has characterized our people since 1918 in relation to this most vital subject? Has it become forgetful of the lessons pointedly brought home to America by the World War of the tragic waste involved in unpreparedness—lessons graphically portrayed not only on the firing line but in every phase of industry which produced the essential materials for the men on the front line?

The vital problem of an adequate national defense has not been lost sight of. In every annual meeting of the United States Chamber of Commerce since 1918 the subject has been placed on an equality with other national issues which compel, or should compel, the attention of every American citizen. Despite the general apathy of the public and the general reaction which followed the high moral fervor and sacrifice of the war days, this federation of business men's organizations has consistently discussed, studied and advocated the necessity of national defense measures.

In 1922 delegates from the member organizations assembled in annual meeting deprecated "any tendency to reduce the authorized personnel of the Army and Navy below the strength conservatively requisite for the preservation of the national safety." In 1924 the delegates instructed the Chamber to indorse: "the policy of preparing plans looking to the mobilization of industry in time of war, and recommend that support and assistance be given to the War Department in carrying out plans now being formulated looking to a more efficient mobilization of industry in the event of war." A special Committee on National Defense was created by the Chamber, of which I have the honor of being chairman, composed of volunteer business men representing the various phases of industry and the geographical sections of the nation, and including men who were able and willing to contribute experiences and first-hand knowledge, gained as manufacturers during the World War, of the problems involved in the transformation of peace-time industries into efficient producers of materials necessary to the nation in time of war.

THIS Committee on National Defense investigated the subject from the point of view of the business community, studied and analyzed the plans proposed, and, above all, coöperated with the Ordnance Department of the Army. As the result of these deliberations the constituent members of the Chamber of Commerce in the annual meeting of May, 1928, adopted a resolution which has since been the platform of the special committee in its attempts to bring about preparedness in industry. The resolution of 1928 reads as follows:

"Modern war is a war of machines and requires these machines in numbers heretofore undreamed of. The capacity of Government arsenals for the manufacture of these machines is small compared with the volume required in time of war. In order that industrial enterprise may in times of peace become familiar with munition manufactures and be prepared to do its part in war production, it is essential that the National Defense Act should be so amended as to permit the Secretary of War to place with industries orders of an educational character for equipment, munitions and accessories. In this manner only can commercial concerns obtain familiarity with war requirements and have their place in industrial war plans of the War Department."

In January, 1929, before the House Committee on Military Affairs, the Chamber through a special committee composed of several members of its Committee on National Defense and of other business men who had furnished munitions and equipment to the Government during the last war, advocated the passage of House Bill 450 which would so amend the National Defense Act of 1920 as to permit the Secretary of War to place with industries orders of an educational character for equipment, munitions and accessories.

What were the views of the Chamber as presented to the House Committee on Military Affairs, in its advocacy of House Bill 450?

It was pointed out that the World War had taught America one outstanding lesson in national defense—the ultimate battlefield where rests the final decision is the factory. Unless we have the facilities and know how to equip without loss of time a modern military force, in which

the use of improved mechanical devices for firing and for the transport and protection of men is rapidly becoming more and more important, we are as helpless in face of a well-organized attack as knights on horseback in the face of gunfire. To be prepared to raise and train a large army of men willing and eager to defend their country, and not to be prepared to place at their disposal the modern munitions and equipment they must have for an even break in battle is not to be prepared. It is as futile as it would be to build warships without guns, waiting until an emergency arose to make guns and to learn how to use them.

We start, then, with the premise that industrial preparedness is a basic factor in any sound policy of national defense. And by industrial preparedness we mean the planning ahead of time for the required supplies and munitions, and the training ahead of time of the managers and workers of our factories so that when called upon they can begin producing war material with maximum rapidity.

The planning has been carried out—on paper—for the theoretical supplying of the mobilized man power by the supply branches of the Army—that is, the Ordnance, Quartermaster and Medical Departments, Air Corps, Corps of Engineers, Signal Corps, and the Chemical Warfare Service. But the weak spot in our industrial preparedness is the training of the managers and workers of our factories so that when called upon they can begin producing war material with maximum rapidity. This weak spot can and should be remedied by educational orders being let out to industry in time of peace.

WE do not have in this country any large privately operated munitions industry, as do some of the countries of Europe. Our Government arsenals have a maximum capacity to produce only from one-half of 1 per cent to 10 per cent of the total requirements in time of war of the various articles of ordnance equipment. For many indispensable articles, therefore, we must rely in war time upon commercial plants which have no experience in peace time with their production.

These factories not only lack experience; they also lack the necessary dies, jigs, and fixtures to produce these non-commercial but indispensable munitions and equipment. The outstanding problem of industrial preparedness is how to provide commercial factories capable of conversion to this specialized kind of war production with the minimum training of personnel essential to keep the art of manufacture alive and with the minimum equipment of tools necessary to insure a rapid conversion from ordinary peace-time to war-time production.

House Bill 450, which was approved by the War Department and advocated by Brig. Gen. C. L'H. Ruggles, former Assistant Chief of Ordnance of the Army, would enable manufacturers measurably to avoid the costly delay in converting a peace establishment to a war basis, at a time when even a few months delay may result in disaster to the nation.

It was pointed out to the House Committee on Military Affairs that educational orders were not designed to be, nor will they be, a profitable source of new business to American industry. While they are of little significance commercially these proposed orders, in the judgment of American business men as represented in the Chamber of Commerce of the United States, would be the means of bringing the defense of our country abreast with the industrial era in which we live.

In presenting a detailed and comprehensive picture of the confusion and delay in transforming the Dodge Brothers plant in 1917 to a war-time basis for the production of much needed ordnance, Mr. Frederick J. Haynes, Vice-Chairman of the Chamber's Committee on National Defense, War Manager of Production of Dodge Brothers, and now the President of Durant Motors, very aptly stated the position of business men. "We started from a dead start," said Mr. Haynes. "Just like a boy who has not learned his A B C's, and all the time our men were over there at the front, and they were going over there, and they were hoping desperately that we would get them something, and we were doing our best, but we did not have any idea what we were trying to do until we got our education.

"There is no money in educational orders for the manufacturers," continued Vice-Chairman Haynes. "But we owe everything we have got to this country. Whether we agree with everything we have here or not, I don't know of any better country to live in. And the manufacturers as a class would be willing and glad to help and coöperate with the authorities at Washington toward the end that we might better preserve this country in time of need. We are all of us for peace, and I know of no better way to get it than through education and by being ready."

Mr. H. H. Pease, President of the New Britain Machine Company of New Haven, Connecticut, speaking as a member of the Chamber's special presentation committee, related similar experiences as a war-time manufacturer of gun carriages and of the delays incurred by manufacturers because of the time, money, effort, and research demanded before actual production began. Other business men supplemented these views of the representatives of the Chamber, and supported the detailed presentation of the objectives of the War Department, as outlined by General Ruggles, in respect of the need and value of educating manufacturers and mobilizing industry as a measure of national defense.

House Bill 450, as is well known, failed to pass during the Seventieth Congress because of the rush of bills. But it is still pending, and its enactment will no doubt be given serious consideration by Congress. The Chamber of Commerce of the United States will continue to advocate adequate preparedness not only in regard to man power but in regard to the equally essential factor of munition power.

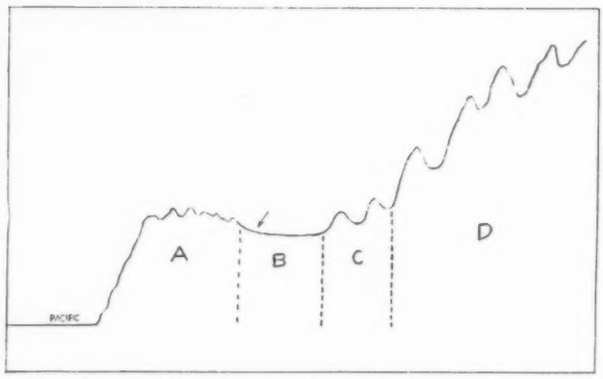
The members of the Chamber's National Defense Committee are public-spirited American business men. Frederick J. Haynes, President of the Durant Motors, is Vice-Chairman, and the other members are A. J. Brosseau, President of Mack Trucks; W. L. Clause, Chairman of the Board of the Pittsburgh Plate Glass Company; Charles W. Davis, President of the Dallas Power and Light Company; Carl R. Gray, President of the Union Pacific System; E. Kent Hubbard, President of the Manufacturers Association of Connecticut; Col. Noble Brandon Judah, of Judah, Reichmann and Trumbull, of Chicago; Bascom Little, President of the Crowell and Little Construction Company of Cleveland; R. G. Rhett, of the Peoples State Bank of Charleston, South Carolina; and Henry D. Sharpe, President of Brown and Sharpe Manufacturing Company of Providence, Rhode Island.

The Chilean Nitrate Industry

Methods of Recovering A Strategic Raw Material

By W. H. Rinkenbach*

THE inclusion of the Chilean nitrate producers in the recently formed cartel of the Continental producers of synthetic nitrogen is of considerable significance. Thirty years ago estimates of the life of the nitrate deposits indicated their possible exhaustion at about the present time and stressed the necessity for developing methods of fixing atmospheric nitrogen. With the successful development in this direction that has since taken place, there arose the impression that, with the further perfection of the synthetic methods, the production of Chilean nitrate would be rendered non-economic in spite of the fact that the deposits have proved to be much more extensive than once estimated. That the industry now appears strong enough to be included in the cartel is contradictory to this and merits explanation.



West to East Topographical Cross-Section of Northern Chile.

A. Coast range; B. Atacama Desert; C. Foothills of Andes; D. Cordillera of the Andes. Arrow indicates location of nitrate deposits.

Since the United States is not self-sustaining with respect to nitrogen compounds, the Chilean nitrate was one of the major essential materials used in this country during the World War, the apparently rejuvenated Chilean industry is of continued interest to those concerned with the materials and munitions of war. Accordingly, this article has been prepared so as to give a summary of the history and methods of, as well as the recent improvements in, the industry which for one hundred years supplied the world with practically all of the fixed nitrogen so necessary in peace as well as war.

THE Chilean saltpeter or nitrate deposits are located in the northern four hundred miles of the country from which it derives its name, being found in the elevated basin which lies between the coast range and the cordillera of the Andes. The northern part of this region is known as the Pampa del Tamarugal, while the southern is named the Atacama Desert. This barren monotone is a true desert, due to the cutting off of rain from the east by the Andes and the similar influence of the cold Humboldt Current along the Pacific coast, and has earned for itself the nickname of the "dust heap of the world" because of the nature of the soil.

The Peruvians of the Incan period were aware of the presence of the deposits and their value as fertilizer but for some unknown reason their use was discouraged. With the coming of the Spanish conquistadores the presence of the deposits was forgotten or disregarded. The generosity with which Peru, Chile and Bolivia on achieving independence shared these desert regions is proof of the small esteem in which they were held. As a result of the war of 1879-1884, Chile now holds possession of all the deposits; outlets for which are found through the ports of Iquique, Tocopilla, Antofagasta, Aguas Blancas, and Taltal.

In 1809 Tadeo Haenke, a German-Bolivian, laid the foundation of the present industry by developing a crude leaching process for the extraction of the nitrate from the *caliche*, as the ore is termed. But few plants were started until 1830, when the value of nitrates as fertilizers was appreciated in Europe. The development of the industry was gradual, being retarded by the primitive methods in vogue, until 1872 when the Shanks extraction system was introduced. At about this time a rapid increase in the world demand for nitrate and the production of iodine as a by-product took place and a period of rapid development began. This lasted until 1884, when over-production caused depression and the formation of the first of a series of producers' syndicates designed to establish an economic balance by limiting production. The World War was the basis of an unprecedented prosperity which was followed by an extreme depression and a return to the syndicate system. Since then the rapid growth of the synthetic nitrogen industry has threatened the extinction of Chilean nitrate, and the economic rehabilitation of the latter must be

A Nitrate Officina in the Atacama Desert; Elevation, 7,500 feet; Andes in the Background.

*Chief Chemist, Picatinny Arsenal, Dover, N. J.

ascribed to new and improved methods developed by research and to the lessening of the export tax burden imposed when the industry represented a world monopoly.

Many of the plants still use the same process established sixty years ago and their modernization will be slow, this being dictated by economic pressure as time passes. This process, based on the Shanks extraction system, may still be considered the standard process, and will be described with respect to materials and methods.

Scene in the Atacama Desert, Chile.

CALICHE, or nitrate ore, is found in patchy deposits, varying in thickness from six inches to fifteen feet and having an overburden with an equal range of depth. In color it varies from almost white to black—the run-of-mill being a light brown—and in texture from that of a baked mud to that of a dense sandstone. The sodium nitrate in the *caliche* varies from 10 to 95 per cent, the run-of-the mill today being from 15 to 20 per cent. Associated with the nitrate are chlorides, sulphates, iodides, iodates, chromates, chlorates, perchlorates, borates, calcium, magnesium, potassium and water-insoluble dirt. An analysis (per cent) of a low grade *caliche* is as follows:

Sodium nitrate 13.6, potassium nitrate 1.3, sodium chloride 19.3, sodium sulphate 6.7, calcium sulphate 2.7, magnesium sulphate 9.7, sodium iodate 0.1, insoluble 44.00 and moisture 2.4.

Many interesting minerals have been found present in the soluble portions of *caliches*. Several of these are peculiar to these deposits. A partial list follows:

Halite, NaCl; sylvite, KCl; potassium chlorate, $KClO_3$; potassium perchlorate, $KClO_4$; saltpeter, KNO_3; nitromagnesite, $Mg(NO_3)_2.6H_2O$; nitrocalcite, $Ca(NO_3)_2.4H_2O$; darapskite, $NaNO_3.Na_2SO_4.H_2O$; nitroglauberite, $6NaNO_3.2Na_2SO_4.3H_2O$; borax, $Na_2B_4O_7.10H_2O$; lautarite, $Ca(IO_3)_2$; deitzeite, $7Ca(IO_3)_2.8CaCrO_4$; thenardite, Na_2SO_4; mirabilite, $Na_2SO_4.10H_2O$; anhydrite, $CaSO_4$; epsomite, $MgSO_4.7H_2O$; gypsum, $CaSO_4.2H_2O$; blödite, $Na_2SO_4.MgSO_4.4H_2O$; glauberite, $Na_2SO_4.CaSO_4$; krohnkite, $Na_2SO_4.CuSO_4.H_2O$.

It is to be noted that carbonates, bromates, phosphates, and ammonium compounds are never, or very rarely, found. This is of importance in evaluating the theories advanced as to the origin of the deposits, since no one of these accounts for the presence of all of the first group and the absence of the others. Our knowledge in this respect must be considered distinctly deficient.

The methods of mining *caliche* are, in general, rather primitive. The first step in the development of a nitrate property, is the survey or *cateo*. *Tiros*, or holes about eighteen inches in diameter and spaced at intervals of 100 meters, are dug through the overburden and *caliche*. The thickness of the *caliche* is measured and a sample taken for the determination of its nitrate content (*ley*). From these data the amount of nitrate present in any given area can be calculated. From this is deducted 40 per cent to approximate unavoidable losses in mining and extraction. On the basis of the resulting figure the value of the area is determined.

Mining operations are almost entirely dependent upon hand labor. A deep trench, or *calichera*, is dug through the overburden and *caliche*. The workers then mine the *caliche* by cracking it with a slow black powder, piling the overburden back of them as the face of the *calichera* is advanced, and piling the broken *caliche* in symmetrical piles on the bank of old overburden. The *caliche* is broken into pieces approximately 8 inches in diameter, by hand. The reasons for the symmetry of the piled *caliche* are that the workers are paid on the basis of a standard cartload and that a stock of piled caliche is held in reserve and this should be measurable. The price paid per cart is dependent on the difficulty in mining due to depth of overburden, etc., and not on the nitrate content of the ore. Areas containing only suitable caliche are mined, the minimum *ley* acceptable being dependent upon other conditions such as the size and richness of the property, efficiency in extraction, market price of nitrate, etc.

The piled *caliche* is transported to the *maquina* or extraction plant by mule-cart or narrow-gauge railway. In some cases the cart-haul is made to the railway. Occasionally, mining camps are established ten miles away from a *maquina* and the caliche hauled by railway to an existing plant, but in most cases the operating radius is much less than this. The *caliche* sent to the *maquina* is usually selected so as to give a fairly even nitrate content.

On arrival at the plant, the *caliche* is discharged into bins feeding the crushers. These are usually of the Blake type, the ore being crushed to 2-inch size. It is then lifted to the top level of the *maquina* by means of an elevator and the actual extraction process is begun.

Scene in the Atacama Desert, Chile.

"Piling back" from Calichera.

THE *maquina* is essentially a series of boiling tanks (*cachuchos*) constructed side to side in a long row, each being about forty feet long, nine feet wide and about nine feet deep. Each contains a steam coil about one foot from the sides and ends and making five or six complete circuits. A false bottom (*crinolina*) permits mud to settle out. Valves and pumps connect and permit the flow of liquid from each tank to those adjacent. From 16 to 20 tanks are usual.

A counter-current system is used. *Caldo*, or hot saturated solution having been drained from a given tank, the less concentrated liquor in the tank "back" of it is allowed to flow forward through it and into a tank "ahead" in which the steam has been turned on and which has been loaded with fresh *caliche*. This forward movement of the hot liquors is brought about by pumping liquor from the 6th to the 5th tank back of that just "cut" of *caldo*. With the start of the pumping, steam is turned off in the 7th tank "back," the weaker liquors in this and the next three tanks being allowed to flow forward. At the same time a weak solution obtained by previous cold water washing (*relave*) is added to the 8th tank back, the 9th tank back is having a first cold water wash, and the 10th tank back is having a second cold water wash. The first cold water wash is circulated by pumping from the bottom to the top of the tank, but the second cold water wash is allowed to act by soaking. If mother liquor (*aqua vieja*) is available, it is preheated to from 60° to 80°C. and passed into the 2nd or 3rd tank back of that "cut."

This accounts for eleven tanks. Of the others in the system, some will be draining, some being emptied, and some being charged with fresh *caliche*. As a fresh tank is added to the liquor system, one at the other end is taken out for draining. A steam pressure of about 30 pounds is usual, although in localities with dense *caliches* a pressure as high as 45 pounds is used. Each tank receives a total of about 20 hours of steaming and eight tanks are "made" per day.

The hot, saturated solution (*caldo*) run from the head *cachucho* contains an amount of suspended mud dependent upon the *caliche* treated. It is run through an open trough to the settling tanks or *chulladores*, where a mixture of flour and manure is added in small amount in order to facilitate settling of the *borra* or slime. This is usually completed within two hours, but *borriente caliche* requires much longer.

The clarified *caldo* is at a temperature of about 85° C. and is now run through open trough-channels to the *bateas* or crystallizing pans. The composition of a typical *caldo* is as follows: Specific gravity 1.483, percentage of water, 38.89; nitrate, 53.59; sodium chloride, 6.99.

The *bateas* are open iron tanks about fifteen feet square and two and a half feet deep. Each is filled to within a few inches of the top and the *caldo* is allowed to cool with daily breaking up of the crust which forms on the surface, a certain amount of evaporation being desirable. This cooling period varies from eight to ten days with the seasons of the year.

Miner in Calichera. The compact lower stratum is caliche.

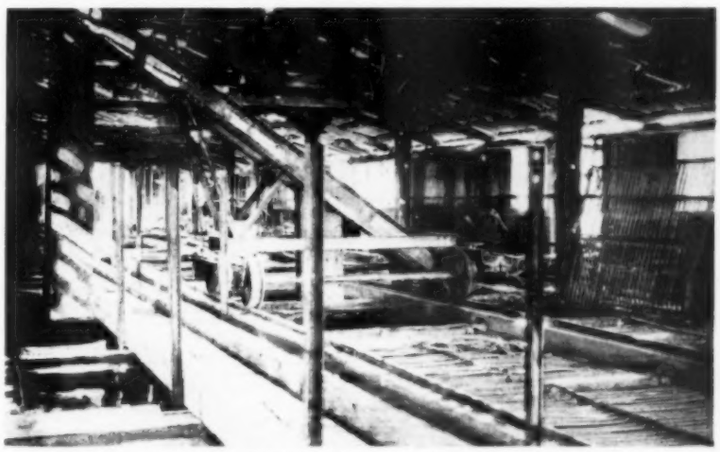
At the end of this time a plug-valve in the bottom of the *batea* is opened and the mother-liquor or *aqua vieja* is drained from the deposited nitrate into a tank. The composition of the *aqua vieja* is approximately: Specific gravity 1.400; percentage of water 54.39; nitrate 31.20, and sodium chloride 11.63.

Containing much nitrate, the *aqua vieja* is pumped back to the *maquina* where, after preheating, it is fed into a *cachucho* containing liquors of approximately the same specific gravity. Here, by virtue of its higher temperature, it is capable of extracting more nitrate but very little additional sodium chloride.

Piled Caliche. Conical Piles in Distance are Overburden Removed by Drag-line Conveyor.

The deposited nitrate is now shoveled from the *bateas* by hand. It is either piled on inclined draining boards and washed by hand-sprinkling to remove mechanically held *aqua vieja*, or transferred to centrifugal wringers and washed.

The washed nitrate, containing six per cent or more of moisture, is transferred to the *caucha* or drying floor and piled for drying by exposure to the arid desert air of the region. At the end of several weeks or a month, the nitrate is bagged by hand. In some cases it has "set" so hard that blasting is necessary. The 200-lb. bags represent the finished product which is shipped to the port on flat cars.



Caliche being Loaded Mechanically into Boiling Tanks in Maguina.

SEVERAL grades of nitrate are standard, the purity of each being determined solely by the thoroughness of the washing and drying operations and judged by the commercial convention known as the "West Coast analysis." In accordance with this, the difference between 100 per cent and the sum of the percentages of the moisture, insoluble, chloride and sulphate contents is considered to be the sodium nitrate content, although the actual content of this may be 5 per cent less. "Ordinary" nitrate contains a minimum 94.5 per cent, "refined" a minimum of 96 per cent nitrate, and "extra refined" a minimum of 97 per cent of nitrate on the basis of the West Coast analysis. Actual analysis of a typical ordinary nitrate is as follows:

Moisture	1.50 per cent
Insoluble	0.19 per cent
Chlorides, as NaCl	2.54 per cent
Sulphates, as Na_2SO_4	0.36 per cent
Sodium nitrate	91.72 per cent
Potassium nitrate	3.00 per cent
Potassium chlorate	0.00 per cent
Potassium perchlorate	0.42 per cent
Sodium iodate	0.01 per cent
Calcium, as CaO	0.05 per cent
Magnesium, as MgO	0.21 per cent

General View of Extraction Plant. Rear left: Belt Conveyor from Crushers to the Maguina in Rear Center. Batea Field in Foreground.

The major, and almost sole, by-product of the industry is iodine, most of the world's supply of this element being derived from this source. The iodates present in *caliche* reach some degree of concentration in the *aqua vieja*, which contains the equivalent of from 1 to 5 grams of iodine per liter. By "cutting" the *aqua vieja* with a solution of sodium acid sulphite, the iodine is precipitated according to the reaction:

$$2Na\ IO_3 + 5\ NaHSO_3$$
$$3NaHSO_4 + 2Na_2SO_4 + H_2O + I_2$$

The sulphite liquor is usually prepared by burning a mixture of sodium nitrate with coal to form the carbonate, dissolving this in water, and passing through this solution sulphur dioxide obtained by burning sulphur dug from extinct volcanoes in the nearby Andes. The precipitated iodine is filtered, washed, pressed and sublimed.

The production of iodine is strictly limited by a syndicate of producers, since the processing of but a small fraction of the *aqua vieja* produced in the course of the year is sufficient to meet the world demand for iodine.

Potassium nitrate was a valuable product at some plants during the World War. It was produced in concentrations of 25 to 30 per cent or 40 per cent with sodium nitrate. This was done by partially evaporating *aqua vieja*, allowing the separated sodium chloride to settle out, and cooling the *H. P. caldo* so obtained. The "high

Old Method of Draining and Washing Aqua Vieja from Nitrate.

A Modern Cancha, or Drying Floor, in Chile.

potash nitrate" deposited was washed and dried in the same way as sodium nitrate.

Potassium perchlorate is a by-product at one plant using *caliche* especially rich in this compound. It is separated from the *caldo* by fractional deposition of the nitrate and perchlorate.

DUE to economic pressure caused by over-production, and the growth of the synthetic nitrogen industry, the methods described above have undergone some improvement during the past ten years and an entirely new method of extraction has been developed.

In the *pampa,* the use of excavators for the removal of light and medium over-burdens has been a step toward the mechanization of a hand-labor operation. This is retarded by the rather low cost of labor.

In the plant, the use of disc-crushers, belt-conveyors, worm-screw washers of the *ripio* (tailings), Dorr thickeners for slimes, and the segregation and separate treatment of ore-fines have been innovations resulting in reduced costs and increased yields of nitrate.

In the construction and operation of the *maquina,* a modification of the Shanks system, developed by A. W. Allen, has presented a distinct improvement. In this the circulation system has been so changed as to reduce the formation of slimes and increase the efficiency of extraction of the nitrate. Here the introduction of heat into the system is accomplished so as to prevent local over-heating in the *cachuchos* and so reduce slime-formation.

Probably the most promising development during the post-war period is the new extraction method originated by the Anglo-Chilean nitrate interests. While no details have been published, the extension of the system to a number of plants, in addition to the one in which it was tested, indicates its success. The method is said to be a cold-water extraction with subsequent refrigeration of the solution. High efficiency in extraction, energy economy, and the practicality of very large extraction tanks or basins are advantages claimed for the method. With the last feature, the possibility of further mechanization represents possible decreases in costs.

Until quite recently, the Chilean Government depended largely upon the export tax on nitrate for its operating income. Recognizing the inevitable, one decrease in this tax has been made in the past ten years and the definite policy of the Chilean Government now includes such a system of taxation as to eliminate the necessity of any export tax on nitrate. This is the result of the adoption of the viewpoint that it is better to have a stable industry supporting many workers but yielding no direct revenue than to obtain income from a dying industry which would also contribute a large problem of unemployment.

The beneficial results of this attitude and of the recent improvements in the methods used have already become apparent in the strengthened position of an industry which appeared about to become obsolescent; and it is anticipated that the production of sodium nitrate from the Chilean deposits will long continue of practical interest to those concerned with the nitrogen supply, so vital in peace or war.

Editor's Note.—According to recent news dispatches, all the vast nitrate interests of Chile have been consolidated in a $375,000,000 organization, the Chile Nitrate Company, in which the Chilean Government is a 50 per cent stockholder. The consolidation, which brings together twenty-eight companies representing more than 91 per cent of the productive capacity of the Chilean nitrate industry, eliminates all other extraction processes in favor of that originated by the Guggenheim interests. The new company, popularly referred to as *Cosanna,* was created under a special law passed by the Chilean Congress. Under this law, according to *The New York Times,* the Chilean Government eliminates in favor of the Chile Nitrate Company and its subsidiaries the Chilean export tax on nitrate and iodine amounting to about $30,000,000 annually. The law also makes available to the new company all the government-owned nitrate lands in Chile. In return the government receives half the stock of the company and is guaranteed a total minimum return for the next three years of $60,000,000. After this transition period the government will rely upon dividends from its stock and a 6 per cent income tax to compensate it for the loss of revenue resulting from the removal of the export tax.

The Chile Nitrate Company will modernize production by substituting large unit plants operating under the Guggenheim process for the many small plants now using the Shanks process. Under the former, ore containing as little as 8 per cent nitrate content can be treated at costs of 40 per cent less than those attained by the Shanks process.

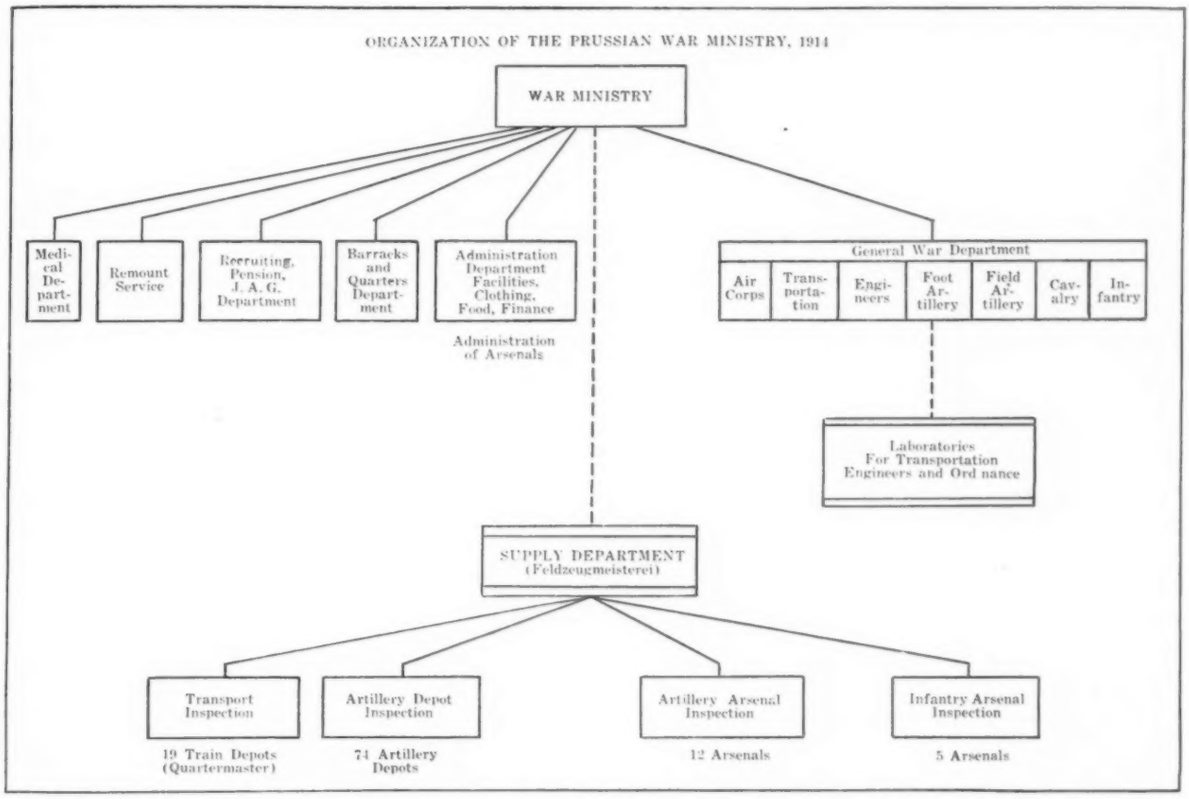
Industrial Mobilization in Germany

The Military Supply System Before and During the World War

By Walter Warlimont*

I AM gratified at this opportunity to discuss briefly the subject of the procurement activities of the German Army prior to and during the World War. To begin with, I have to confess that I did not take part in procurement operations during the war as I was on duty with troops during the entire period. The following is based on studies I made during recent years in the German War Department.

That this main and fundamental mistake, the lack of sufficient economic preparations, has been recognized by your country, is assuredly proved by the institution of your Industrial College and the successful activity of all your supply branches headed by the Planning Branch of the office of the Assistant Secretary of War. In spite of this I must briefly describe the extent or rather the lack of



It is hardly necessary to emphasize the fact that the military procurement phase of the German economic history of the World War cannot and does not want to be regarded as a model. In fact, deficiency and growing need were characteristic of the German procurement operations from the very beginning of the war. On the other hand, this situation has produced results which, from the point of view of their technical effects, have laid the foundation or have changed various manufacturing methods entirely. Such results also allowed a country of relatively small size, with its frontiers closed, permanently to secure the supply not only for its own but also frequently for its allied troops. I shall endeavor to give you a brief survey of German procurement during the war and to call your attention to what is perhaps of special importance today, even though partially, to avoid those mistakes in the future which were made by Germany in the past.

*Captain, Field Artillery, German Army.

procurement preparations by Germany in 1914 in order to create a basis for an adequate understanding of what follows.

THE organization of the German Army and Navy at the beginning of the World War was not favorable to uniformity of procurement preparations. Due to history and tradition, it varied considerably from the normal practice in other countries. There was a Naval Ministry in the Federal Government headed by the Secretary of the Navy, an admiral. A Secretary of War, however, did not exist in the Federal Government. Each of the greater states (Prussia, Bavaria, Saxony and Württemberg) had its own war minister, in each case a general officer. He was a member of the respective state government and in that position responsible to the Parliament. The Prussion War Minister, as by far the most important, was prëminent and, whenever necessary, represented the army in the Fed-

eral Government also. But the highest and most influential position in the army was that of the Chief of the Great General Staff. The Great General Staff was not a part of any war ministry, rather being an authority of itself. Its chief was responsible for the defense of the entire nation and for the war plans, reporting directly to the Supreme War Lord. The necessary resources, however, such as manpower, material and money, came from the various war ministries.

Wagons left by Germans at "Karthaus," an old Fort at Coblenz, Rhenish Prussia, Germany; American Sentries on Guard. More than 750 Wagons were Abandoned at this Place. December, 1918.

From this situation it can be concluded (and there are other reasons also), that as a rule the Great General Staff presented demands while the war ministries, hampered by political influence and appropriations, often had to diminish its high aspirations. Therefore, it is not astonishing that the suggestion was repeatedly made by the Great General Staff to increase the industrial war preparations, but less astonishing that these suggestions were decreased by the war ministries for lack of funds.

It does not seem necessary to go into further details as to how the Prussian War Ministry, shown on page 115, at that time was organized for supply. It is sufficient to say that the various departments of the ministry, especially the sections of the General War Department, decided upon the amount and the types of equipment and subsequently gave their orders to the Supply Department (*Feldzeugmeisterei*) to carry out the procurement, but even this department had no active procurement organization. In fact, it passed the procurement orders to the respective arsenal inspections which had them carried out by their own arsenals or by certain private firms.

IF it seems that decentralized procurement existed to some extent, centralized control was entirely lacking, and decentralization of procurement was not systematically organized. Procurement was not organized on a basis of material but was carried out according to the various using branches. So, for instance, field and foot artillery had entirely different fire-control instruments for the same purposes and also different harness. There was different signal material in all branches. This multiplicity of types proved to be the more confusing since four war ministries, as mentioned before, were procuring in the same manner. Furthermore, in addition to the arsenals, quite a number of chiefs of branches, especially of technical troops, many other military institutions and, in some cases, the troops themselves were authorized to procure.

This procurement organization, if it deserves that name, very soon proved to be unfit for the requirements of the World War, particularly as it was weakened by the transfer of many officers to duty with troops at mobilization. The war itself, in fact, created soon an organization of its own to which I shall refer later.

No more than the organization could the reserves of munitions themselves be adapted to the needs of a World War lasting for years. The modern principle, that the material mobilization of a country relies upon the preparedness of its entire industry for war, the reserves of finished munitions being a supply only up to the time when industrial preparedness comes into effect, had not yet been born. By saying this, I do not want to diminish the actual value of those reserves. On the contrary, it is well known what high importance is attributed them by some nations in the Preparatory Commission of the Conference for the Limitation of Armaments at Geneva. In 1914, however, the reserves were almost the sole resource of the material preparation as a whole. Much less value was attributed to the possibility of supplementing these reserves than to keeping the amount in storage as large as possible.

The amount in storage had been computed for the initial equipment and consumption of the regular army and the anticipated reserve units. As the result of the Russo-Japanese War, the amount of ammunition in storage had been largely increased during the years preceding the World War. The amount required by the General Staff, however, had not been attained up to the outbreak of the war. The repeated request of the General Staff that the stored amount of ammunition had to cover the period of time up to the beginning of war-time deliveries had by no means been fulfilled. There were, for instance, 1,000 rounds for each piece of the field artillery. The stored amount of rifles and rifle ammunition was large. No reserves, however, existed in machine guns which were considered a new weapon at that time though several hundred were in process of manufacture. For the field artillery there was a ten per cent equipment reserve in store. The foot artillery was to be supplied primarily with such guns as were kept in fortresses which were not attacked. The stored amount of signal material and carriages covered only the essential mobilization requirements.

The amount in storage, although always a compromise between the requirements of the General Staff and the efforts of the War Ministry, proved entirely efficient. The German army took the field in splendid equipment. In a very short time, however, a deficiency of requirements was discovered in two very important directions: The consumption of artillery ammunition surpassed all expectations as much as the number of new units, which, based on hundreds of thousands of volunteers, were formed soon after the outbreak of the war.

The supply was, in war-time also, primarily to be provided by military arsenals. Their production was to cover almost forty per cent of the anticipated requirements. Their mobilization orders provided for the possible increase of production. Also a certain amount of material was permanently kept there in order that the increased production might be started immediately and continue for three months. The arsenals not only met these demands but exceeded the estimates corresponding to the increasing requirements. They could, however, not be utilized to the utmost and were not suitable for instructing private industry since their methods had not kept pace with modern development. Their machines were obsolete and their drawings could not be understood by private firms.

A similar preparation existed for those firms of private industry which in peace time permanently furnished supplies for the army. The best known among them are Krupp and Ehrhardt who manufactured guns. Endeavors to increase the number of these firms were often made during the years just prior to 1914. The leading idea was to restrict the monopolizing position of some few firms, especially of Krupp, and to prepare a larger number of them for munitions work by educational orders. The relatively small amount of peace-time requirements and the high costs of such occasional orders restricted the results of these efforts. Consequently, the number of these plants which manufactured guns, rifles, powder and ammunition, amounted to twenty-five in all in 1914. There were 35,000 at the end of the war. To mention another figure, the production of all military and private plants together amounted to fifteen pieces of field artillery in 1914, that was twenty-five hundredths of one per cent of the initial equipment. In 1916 two thousand field guns were manufactured in one month.

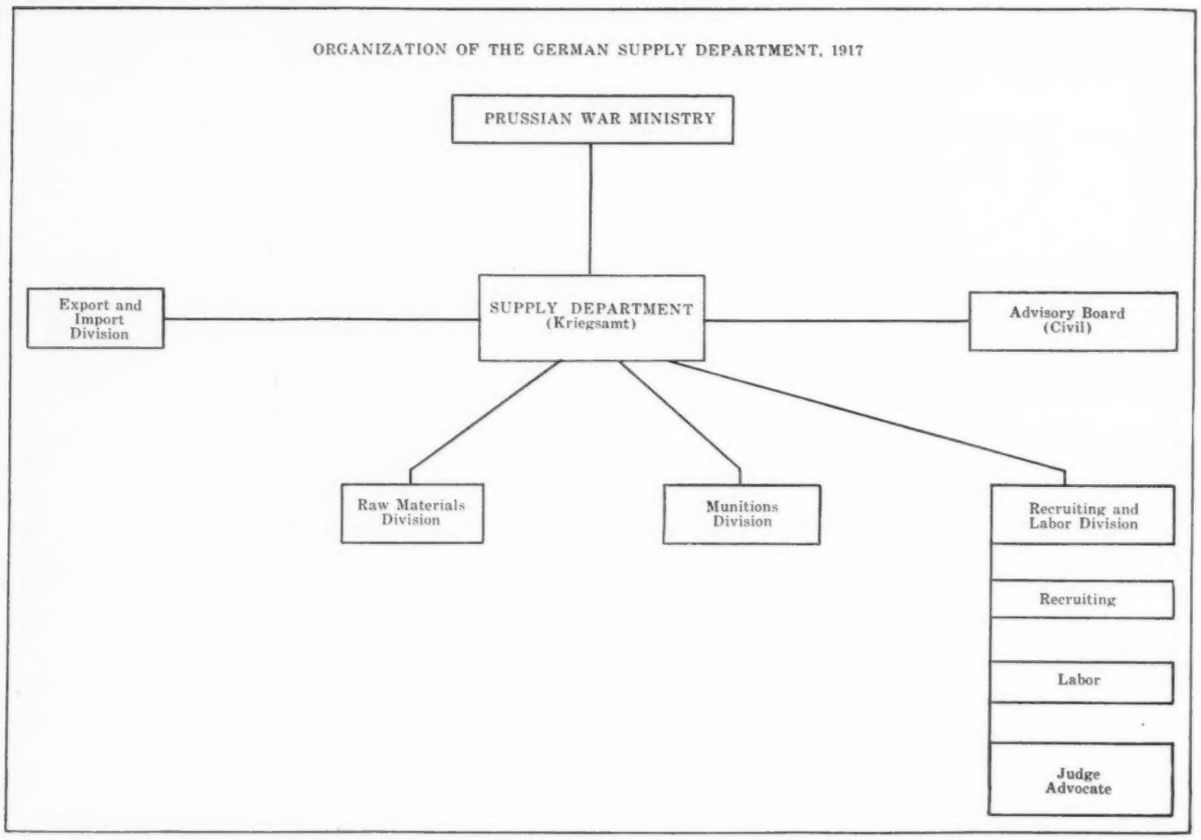
Besides the preparedness as described for the arsenals and for the private munitions industry, the arsenals had made contracts with certain other firms for deliveries of ammunition in case of mobilization. The number of these firms was primarily restricted by the high requirements as to the quality of war material. Also, it was feared that the uniformity of the material would suffer from taking in more firms. Only in the case of field artillery ammunition, the supply of which was highly critical, a special design was prepared suitable for quantity production, the cast iron shell, which in fact helped over the worst period of ammunition shortage in 1914-1915. An inspection of these facilities with regard to their capacity was not carried out in general. Indeed, many of them could not fulfill their obligations at mobilization as their workmen were withdrawn by another military authority and the needed raw material could not be procured in time on account of the utilization of all railroads for the transportation of troops.

Captured German Small Arms, Machine Guns and Cannons in the Square at Villers Cotters, France. July, 1918.

OUTSIDE of the Army itself there was no industrial or agricultural war preparation of any kind. A plan calling for governmental subsidies to secure at least the corn supply during the summer months until the coming in of the new crop had been denied by congressional commissions. Agricultural as well as industrial circles could not picture any more than the military circles to what degree their own active participation in war time would be necessary. Everyone was convinced that war would necessarily condemn all industry except the munitions industry to complete idleness. In fact, to mention a drastic example, the German steel production decreased from one and one-half million tons in July, 1914, to one-half million tons in August, 1914.

Regarding this situation, it is hardly necessary to say that neither industry as a whole kept a stock of semi-finished or raw materials to provide replacements to meet possible difficulties in war time nor that the military authorities had any influence or control in that direction. The actual stocks of this kind became known only by an investigation made shortly after the beginning of the war under the direction of the Prussian War Ministry. At that time it was found that the stocks would cover the requirements of normal production for a period varying between three and ten months.

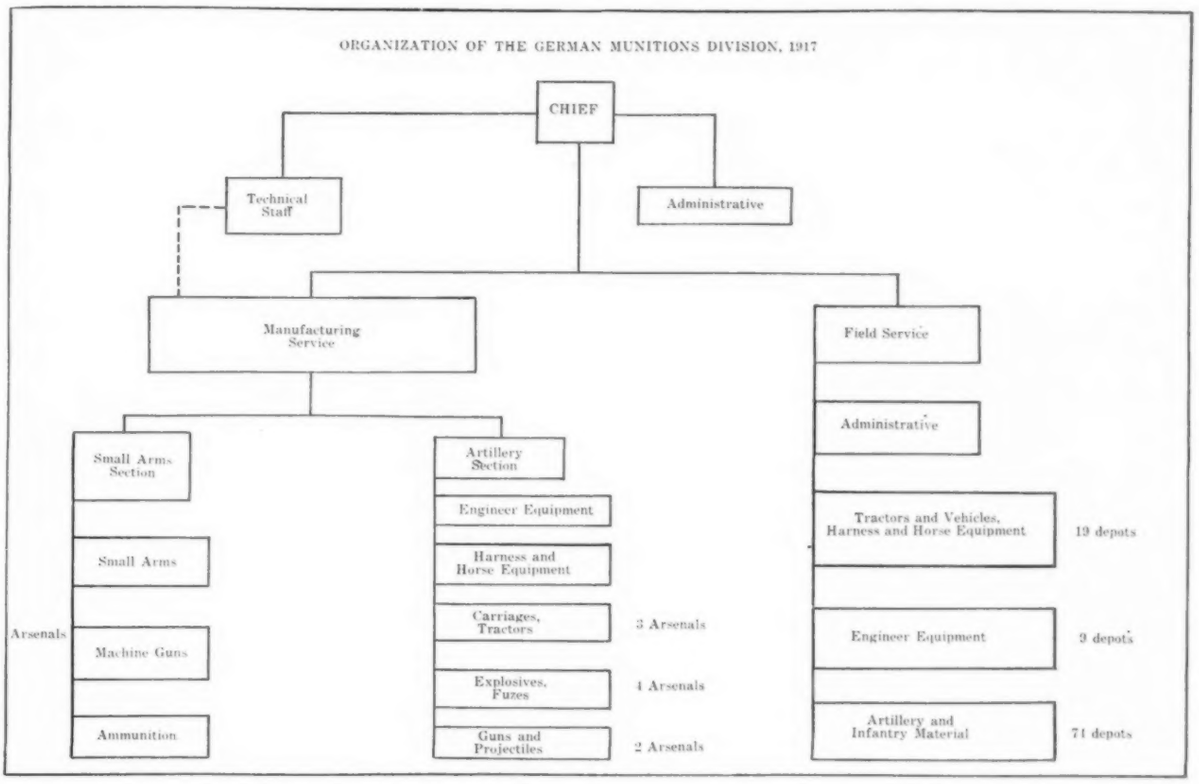
In an actual industrial preparedness for war, it would have been of special importance to have control over such stocks in a country like Germany which depends to a great extent upon the importation of raw material and the



coasts of which, short as they are, could be blockaded easily. The production of industrial raw materials in interior Germany at that time made the country self-supporting only in coal and potash, nearly self-supporting in zinc and lead. The German production, however, of other raw materials of high importance for war supply such as iron, manganese, copper ore, oil, saltpeter, rubber, and cotton, to mention a few, was either non-existing or insufficient to meet even the peace-time requirements. Moreover, such raw materials as existed in Germany itself were to be found close to the borders in the East and in the West, and consequently were specially exposed to hostile attacks from the ground and the air. Furthermore, these strategic raw materials, as far as they had to be imported, came from countries whose political pre-war attitude or geographical situation overseas made it improbable that a continuing trade was to be expected in war time. The indispensable iron ore was, however, a valuable exception as it was imported from Sweden by way of the Baltic Sea which was controlled by the German Navy.

The industrial power in Germany at that time was almost entirely furnished by coal. The high value of brown coal or lignite had not yet been wholly recognized and it had only been made accessible to a small degree. The organization of power in connection with war had never been considered. The transportation facilities, first of all the highly developed railroads, were splendidly prepared for the transport of troops and supplies. The statutory provision, that the entire railroad system would be immediately put under military authority at the outbreak of war, proved highly satisfactory. However, the plans, based on previous experience and the assumption of a short war, made no provision, either to utilize the railroads economically for war industry, especially by choice of the shortest routes for the necessary transports of material, or to keep the railroads themselves in efficient condition.

IN view of this situation, the far-sightedness and the influence of a great man were necessary to show and counteract a dangerous gap in the national preparedness for defense, when in the first days of August, 1914, the purely military preparations gave a brilliant test of their efficiency and no link in the chain of mobilization seemed to be lacking. This man arose in the personality of Walter Rathenau, then Chairman of the Board of the General Electric Company, after the war temporarily German Secretary of State and in this position assassinated by fanatics. In the first days of mobilization, Rathenau called on the Prussian Minister of War, then General von Falkenhayn, later Chief of the Great General Staff, and reported to him his doubts and proposals as to the critical raw material supply of German industry and the danger resulting therefrom for war supplies as well as for the maintenance of the domestic economic life. Perhaps for the first time the problems of an "assurance of adequate provision for the mobilization of material and industrial organizations essential to war-time needs" were realized and their solution first attempted. It seems to be of special significance that these problems were for the first time enunciated in this somewhat concrete form by an industrial leader, and, of as much significance, that they were directed to a general of the Army who immediately recognized their importance and put into effect the



first necessary measures. They consisted in creating a section for raw materials (*Rohstoff-Abteilung*), which was attached to the War Ministry under the direction of a civilian, Rathenau himself. His first action was to collect statistical data of the raw material stocks of industry. It should be emphasized that there was no law on which to rely for this purpose. The only governmental regulations with respect to industry issued with the mobilization order, prohibited the export of some of the most important military supplies. It was a voluntary act that industry furnished these statistical data with the before-mentioned result. This was the very first beginning of a military procurement organization in Germany, which will be discussed in its organization and technical, economic and social operations.

The procurement organization, in fact, remained an improvisation until the end of the war. Originating from almost nothing, its problems grew faster than its machinery, and the lack of material, which it sought to remedy, was equal only to the perpetual lack of men available and suitable for this far-reaching duty.

IN particular, the following seems worthy of mention:

The entire procurement organization, instigated by the action of Walter Rathenau, was under military command, excepting the administration of food and of certain raw materials, such as coal and potash, in which Germany was self-supporting. Consequently, the producer as well as the distributor and the consumer mainly looked upon the military authorities as those who were responsible to the entire nation. Certainly, this solution of the problem was welcomed by the military administration which did not fear the responsibility. And indeed the first measures were only intended to conserve the indispensable war material for the use of the only then justified consumer—the fighting forces. Also this solution adapted itself to the German war regulations, since, according to them, all executive power in the interior was held by the military authorities. And for sure, the most necessary steps in this new development were put into effect more quickly by the military authorities than could have been expected from a civilian department. Moreover, the military authorities employed all leading industrialists of the country, partially in consulting, partially in active control positions, as Rathenau himself.

However necessary, logical and efficient it seemed to subordinate procurement under the military organization, nevertheless it must be conceded that this solution had its disadvantages. They increased as the whole nation was drawn more and more into the struggle and consequently the entire industry of the nation more or less was put under military control. In spite of civilian experts, mistakes were made in procuring supplies under this military control, which resulted in material advantages to certain civilian interests at the expense of others. It is contrary also to the general feeling of justice that the principal consumer of an article at the same time decides as to its entire distribution. From a psychological point of view it is a heavy strain upon the supreme military authorities to be charged not only with the responsibility for the actual conduct of war, but for procurement also. Confidence lost on this side is also immediately a loss on the other. It therefore seems better to avoid the appearance even of a military economic dictatorship. It is preferable to divide the burden of responsibility and to claim only that part of industry for military authority which, based on previously completed plans, is necessary for the actual war supply.

THE procurement organization was attached to the Prussian War Ministry. It extended, after arrangements with the different states, over the area of the empire and the occupied zones beyond the frontiers.

The peace-time organization was herewith upheld. The General Staff conducted the war in the field. So doing, it gained many areas which in their mineral resources greatly helped the war supply, as for instance the ore basin of Longwy-Brie in France, the copper mines of Bor in Serbia, the Roumanian oil fields. It must be said, however, that the occupation of those areas was not undertaken for the special purpose of increasing the war supply as certainly might have been done. On the other hand, the General Staff demanded an ever increasing amount of munitions from the War Ministry and therefore urged it to utilize all resources and to attain results which seemed beyond the capacity of the country in the estimation of the War Ministry. And yet in another way the military command in the field supported the industrial operations, namely, by the careful control of an economical consumption of all material and by the collection of captured as well as used material (such as cases, ammunition baskets, etc.).

Minenwerfers and Hand Grenades Left Behind by the Germans in their Departure from the Argonne, near Montfaucon, France. October, 1918.

Only the zones under direction of the Navy and the Marine Corps were excepted from the general commandeering of material. This certainly was a mistake which could not be remedied, however, until the autumn of 1918 when the situation was most critical.

From 1916 on the most important branches of the procurement organization were combined in the so-called *Kriegsamt*—Supply Department, the first Chief of which was General Groener (at the present time German Secretary of Army and Navy). This Supply Department was expanded to a large procurement organization which was composed of the four elements of procurement, as shown on page 118: raw materials in the Raw Material Division, facilities in the Munitions Division, manpower in the Recruiting and Labor Division, and finally several price control and contract sections, incorporated in the Munitions Division. An advisory board of industrialists was attached to the Department.

From the point of view of organization the Raw Material and the Munitions Division deserve special comment.

THE administration of the Raw Material Division was first extended only to some specially important, that is indispensable raw materials, not to be found in the country and the stocks of which were very small. The practice of control, first administered by the Division, consisted of prohibiting any export without special permit and any other use than for military purpose. Besides that the department did its best to increase the importation and stocks of these materials.

With the duration of the war the number of strategic raw materials constantly increased resulting in a corresponding increase in the number of subdivisions of the Raw Material Division. Also the control measures had to become more severe. It became necessary to compute requirements each month, to examine them and to give special orders concerning methods of procuring them. In order that this might be accomplished, the methods, still recognized today, were: to divert first the non-military, and later the military, requirements to less rare material or substitutes, to restrict consumption, to increase production in the interior and in the zones of occupation, to initiate and to support scientific research work. The mobilization of private property, such as church bells, house and kitchen utensils, finally adopted by the Department, proved to be very successful, but it should always be regarded as a last resort.

Beside the Raw Material Division and corresponding to its subdivisions, each commandeering a certain material, a great number of so-called *war companies* (*Kriegsgesellschaften*) were founded. It was their task to assemble and store the material as far as it was not in private hands, to distribute it to the authorized consumers and to perform the settlement of accounts connected therewith. They were companies, incorporated as civilian concerns, which represented the producers of the respective raw material and which were controlled in their business by a commissioner of the Raw Material Department, who generally was an army officer. These companies were, to some extent, examples of an organized economy conducted by the government, but abusing its authority, they often served to promote the capitalistic interests of some individuals. This fact, in connection with an extensive centralization—nearly all these companies had their headquarters in Berlin—and the other fact that the interest of the legitimate trade as well as of the consumers were seldom represented, aroused at length great indignation. The war companies became, from the point of view of the population, the source and places of cultivation of profiteers. It must be conceded that the

actual trade of raw materials could not also be performed by the military authorities, that is by governmental employees or officers, as was demanded by some at that time, even with an additional demand to assemble all stocks at certain depots to be operated by the government. A far-sighted industrial preparation, however, will be able to get along without such companies or at least limit the number of new organizations and rather make use of the existing peace-time trade organizations as far as possible.

THE Munitions Division had gradually developed from the *Feldzeugmeisterei*. The last impulse to its foundation was given by the so-called "Hindenburg Program," which demanded a tremendous increase in the production of munitions and for the first time gave definite figures as to the amount of requirements. Hindenburg in 1916 categorically presented demands for double the amount of ammunition and tripled the requirements of artillery and machine guns. Up to that time the request had been only for "as much as possible."

That the arsenals were not able to fulfill their procurement duties in addition to their increased manufacturing service had become evident early in 1914. The *Feldzeugmeisterei* itself had to take charge of procurement. At the same time the number and the activity of all the other military agencies involved in procurement was increased. It is hardly necessary to say more about the procedure of procurement of those early months which was characterized by competition between the procurement branches, by lack of knowledge of capable firms and by outbidding in prices. The orders were given to industry and trade wherever they offered their services. Verbal contracts were the rule. It was the same development which all the countries participating in the war had to undergo.

The organization of the Munitions Division meant an important improvement. To put the entire procurement under centralized control was, however, not attained successfully even until the end of the war. The Munitions Division was rather a supply branch (page 119), which has a striking resemblance to the Ordnance Department, U. S. Army, in the field of its duties as well as in its organization.

Among the improvements, the creation of the Technical Staff deserves to be particularly emphasized. This staff, under the direction of a civilian chief engineer, could finally make the attempt to introduce the principles of quantity production in the procurement of munitions. At the same time, it became an important advisory board for private firms first starting to manufacture war material. Also the problems of procurement of industrial power as well as of machines and tools, up till then neglected, came under the centralized control of the Technical Staff. For the procurement of machinery, boards were created throughout the country which were authorized to expropriate machinery and to assign it to other places where it was needed. Their activity extended also to machinery in the zones of occupation which under strict observation of international obligations was transported to interior Germany. To start work in the foreign plants themselves had proved in most cases far less efficient. The centralization of inspection in the Munitions Division Field Service was of similar importance, as the inspection up to that time had caused many difficulties and delays in production either by narrow-minded interpretation of the regulations or by unreliable and untrained persons.

Section of German Supply Base, Near Cheppy, Meuse, France. October, 1918.

On the other hand, there were many complaints that the sharp centralization of procurement as carried on by the Munitions Division had often caused an unjust distribution of the load or the profit to manufacturers throughout the country, that ignorance of local conditions had often hampered the full utilization of production facilities and that it had led to much unnecessary transportation. The result of a scientific investigation made after the war sets up the correct principle that there ought to be one directing authority in procurement which should however have only the control. The distribution of the orders themselves ought to be performed rather by "sub-central sections" as they called them, spread throughout the country. This proposal corresponds in a striking manner to the present procurement organization of the United States Army.

IF the war-time procurement organization gradually disappeared after the war in favor of free economy, its scientific technical results exist in Germany to this day. It would lead us too far if I should specify all the substitutes in use in Germany during the war. The success of the German war economy, or rather war science, on this topic is known all over the world! Let me just mention some few facts:

The first and most important results of this kind was the creation of the facilities for extracting nitrogen from the

air. The Haber-Bosch system, still in use in the German chemical industry, was near perfection at the beginning of the war. The first facilities for mass production, however, were created as a consequence of the war because only in that way the German manufacture of powder could be safeguarded beyond the spring of 1915, at which time the small stocks of Chile saltpeter would have been consumed. Today Germany is exporting several hundred thousands of tons of this artificial saltpeter annually.

Lack of copper led to the foundation of the aluminum industry, which, although based on foreign raw materials, represents a very important factor in the German economy of today with an annual production of almost 30,000 tons.

The lack of oil had highly important influence on the use of benzol, which is recognized in Germany today as the most valuable fuel and of which more than 300,000 tons a year are extracted. At the same time the first experiments for the liquifaction of coal were attempted. The use of alcohol as fuel became almost as important for Germany as that of benzol and is still kept up with good results. Finally, the application of medium and heavy oils and thereby the use of the Diesel motor were especially promoted by the needs of the war.

A somewhat less perfect substitute which, however, was very important for Germany at that time was the artificially-made rubber. Experiments to the end of its material improvement as well as to decrease the costs of manufacturing have never stopped since the war. It was recently reported that artificial rubber has proved fit for pneumatic tires while it was formerly restricted to solid ones.

Finally, the needs of war have repeatedly caused the opening of new or the enlarging of already existing mines, which have proved to be valuable also under post-war conditions.

In contrast with these outstanding results in raw materials, the experiments performed to simplify the manufacturing methods seem to be of less interest since it is in your country that these experiments have been advanced so astonishingly after the war. The fundamental principles have already been discussed in describing the organization of the Munitions Division especially of its Technical Staff. The trend to standardization and simplification, today as alive in Germany as over here, originated in Germany from this military authority.

TOGETHER with the technical problems, quite a number of important economic problems grew up, for which at first no experienced personnel was available in the military departments. There was no lack of money which was raised from interior loans, but an effective use thereof was often lacking.

Besides the before-mentioned multiplicity of agencies engaged in procurement, this defect primarily became evident in formulating contracts. The simple peace-time procedure of price control, based on the manufacturing experiences of the arsenals could not be applied to the quantity production of war time. This mass production especially felt the lack of security of peace-time orders with regard to their continuity and duration. The idea of a short war prevailed in the beginning. Later a clause was added to many contracts with regard to demobilization, which contributed to a great extent to the fact that the industry demanded and received large premiums for the risk involved. This, in connection with the general need of all materials, resulted in a tremendous and ever increasing rise of prices. Furthermore, the government suffered great losses by spending or contributing money for new industrial buildings, for the investigation and opening of mines, or for scientific research work, this money often being given without further obligations from the recipients.

A favorable change also in this field was accomplished at last by the creation of the Munitions Division. Three subsections of this Division had to control all procurement contracts, which as a principle were to be based on the price of one piece of each article: these were a Central Judge Advocate's Section, an Economic Control Section (both in the Administrative Section) and a Technical Control Section, incorporated in the Technical Staff. In a similar way the new buildings, to which the Government contributed, were supervised.

The participation of the distributing industry in the great process of war-time procurement went through a rather interesting development. At first the trade representatives were highly welcome to the procurement authorities, since they often disposed of stocks immediately available and since they had such knowledge of firms as was lacking to the procurement officials. Gradually, however, this system was abused by commission agents. Yielding to the protests of regular industry, the procurement authorities finally attempted to end the disorder and arrived at the other extreme, of eliminating the middleman entirely and of restricting business to the firms themselves. But this procedure also was recognized as a failure, since the elimination of the middleman and therewith of a great part of competition further increased prices. Moreover, trade could not be eliminated in many cases as, for instance, in assembled articles. So at the end, honest trade proved to be an indispensable link in procurement.

As to export and import, the already mentioned export prohibitions, issued with mobilization, were partially abrogated shortly thereafter. For iron and steel, for instance, the reasons were the small amount of their domestic requirements during the first months of the war, which forced the iron industry to go into the foreign markets in order to maintain its existence. Also, the necessity of procuring foreign money as well as other political and economic causes forced the continuation of export to neutral states. Exportation, however, remained under permanent control of the government. A firm which exported finished articles containing rare metals was obliged to import the same amount. Articles, especially chemicals, in which Germany held a world monopoly, were authorized for export only to such an amount as corresponded to the pre-war buying of the respective country. A special supervision as to the destination of these goods was to prevent the export from neutral to hostile countries. The export to allied countries became more and more an important factor. As to import, an interesting attempt was made by the war ministry in 1915 to restrict the import of iron ore from Sweden in order to eliminate the influence of this high-priced ore on the prices of domestic iron ore. It is remarkable that this attempt, although it was not carried through because of

growing requirements, resulted in a large increase of the national production of iron ore.

LABOR was one of the most difficult problems all through the war. According to the German peace-time opinion, every able-bodied man had to do duty with troops on the front line. Exemptions for the munitions industry, therefore, had taken place only to a very small extent. Even the arsenals at mobilization had to dismiss a large part of their best workmen for duty with troops. In spite of this, there was at first no numerical lack of labor since many industries had to restrict or to close down their plants. Also, the suspension of certain restrictions imposed by labor laws as, for instance, with regard to working hours, employment of women and minors, proved to be very useful. Beginning in autumn 1914, women took over a great part of the work of the country. Later on their number amounted to four millions of which fifty-five per cent were occupied in the electrical, twenty-three per cent in the chemical, nineteen per cent in the metal and machine industry. In agricultural work women were the backbone. The labor unions for their part contributed to the improvement of the situation by resolving not to pay any strike bounties.

German Motor Transportation Turned Over to the Allies in Accordance with Armistice Terms. Sentries on Guard. Montabaur, Germany. December, 1918.

On the other hand, the lack of engineers and skilled workmen proved to be so great that it could be remedied only by ordering back men out of the front line. Herewith a new difficult and tedious task arose for the military authorities. Industrialists often accepted large orders and after signing the contract, demanded the return of a large number of their skilled workmen in order to fulfill the contracts. The procurement authorities attempted the reverse procedure, to issue an order only if the manufacturer agreed to get along without a new demand of labor, but they did not succeed. Finally, also, on this line of procurement the only remedy was to organize from the very bottom: industry was required and helped to create schools for the education of skilled workmen.

Many disagreements developed in connection with the return of laborers from the front lines. The soldier was temporarily dismissed from active service and was given leave for work at a certain working place. The employer wanted to regard this leave as applicable only to his own firm and from this point of view often attempted to make work compulsory at his place. Often the employer put these workmen to an alternative decision of working at his plant or of being reported by him as free for duty with troops. The employee wanted to conserve his right of free labor and was often supported therein by other employers who tried to take away from each other the best skilled workmen. The military authorities did their utmost to keep these laborers at the place first designated to them, for instance, by supervision of public employment bureaus and newspaper advertisements, but they always declined to lend their aid to any compulsory labor not expecting any results therefrom.

Contemporary with the Hindenburg Program, a far-reaching, new regulation was attempted by the General Service Law (*Hilfsdienst-Geseta*), which, following the example of other countries, was to increase the amount of labor by a certain obligation of the entire able-bodied manpower. According to this law, every male German from his seventeenth to sixtieth year was obliged to render patriotic service of some kind, if not in the front line then at home. Every activity which directly or indirectly served to support the conduct of war was considered as service of this kind.

The opinion as to the effect of this law until this day still is divided. Many believe that a moral appeal to work—and it was only a moral appeal—was not sufficient in the then weakened condition of Germany. Many believe that more severe compulsory measures would have resulted in a wide-spread indignation of the workmen and consequently in a decrease of efficiency. At any rate, the law did not succeed in its provision for preventing workmen from changing their working places. This provision prohibited any workman from being employed at a new place until two weeks had elapsed after leaving his former one.

It is a fact that in spite of this law, the number of those recalled increased from six hundred thousand to two and a half millions in order to meet the Hindenburg Program. Out of a total number of eight and a half million able-bodied men, that meant a tremendous figure and consequently led to repeated attempts to send back a part of these men, especially the younger ones, to the front lines.

The continued exchange of manpower between front line and industry was one of the causes for many attempts brought about by the simultaneous pressure of food conditions in Germany to bring into accord the high wages of labor with the small pay of soldiers. A solution of this problem could not be reached.

Based on existing figures, permit me, in conclusion, to answer a question often asked: It was *not* a lack of material which caused Germany to lay down her arms in the autumn of 1918. Consequently, it may be stated that the German procurement agencies as well as German industry, in spite of enforced reliance on their own limited resources, in the end successfully met the strain of more than four years of war.

X-Ray Tests of Welds

Technique as Developed at the Watertown Arsenal

By H. H. Lester*

MODERN economic civilization with its colossal industrial developments demands from structural units the utmost in dependability of service. Engineers, whether they design large buildings or intricate mechanisms, must be sure that each individual part can be relied upon to perform its appointed task under all conditions of continuous or intermittent service. Steel is perhaps our most important building material. We can make in this country as fine a quality of steel as can be made anywhere. But if this fine metal is poured into a defective casting or forms part of a defective weld the resulting structural unit cannot deliver in service the strength or durability of which the metal is inherently capable.

X-ray testing to determine the soundness of cast metal was started at the Watertown Arsenal in 1922. It was demonstrated quite clearly that the tests were reliable for detecting such defects as cracks, pipes, inclusions and blow holes. More important, it was found that the method furnished information which, used to control manufacturing technique, made possible the effective elimination of such gross defects.

The metal of a gas or electric weld solidifies from the molten state and is essentially cast. X-ray tests can be used to determine the soundness of this metal just as they are used for the similar purpose in other cast metal. They may be used to develop a technique that gives completely dependable welds.

THE work with castings indicates that the better field for x-ray inspection is in its application to develop the procedure for making perfect castings rather than in its use to condemn bad ones. So it is in welding. The best use of the method is its application to produce good welds rather than in its use to condemn bad ones.

X-ray negatives are not easily reproduced. For this reason the illustrations accompanying this article show exaggerated cases of defects. In practice the negative is studied. Fig. 1 illustrates an x-ray picture of a defective weld, together with a photograph of the weld. The black spots represent gas cavities. On visual inspection the weld appeared perfect. In fact, it was the best looking weld that had been produced at Watertown up to the time of its making. The x-ray picture showed it to be really about the poorest one that had been produced.

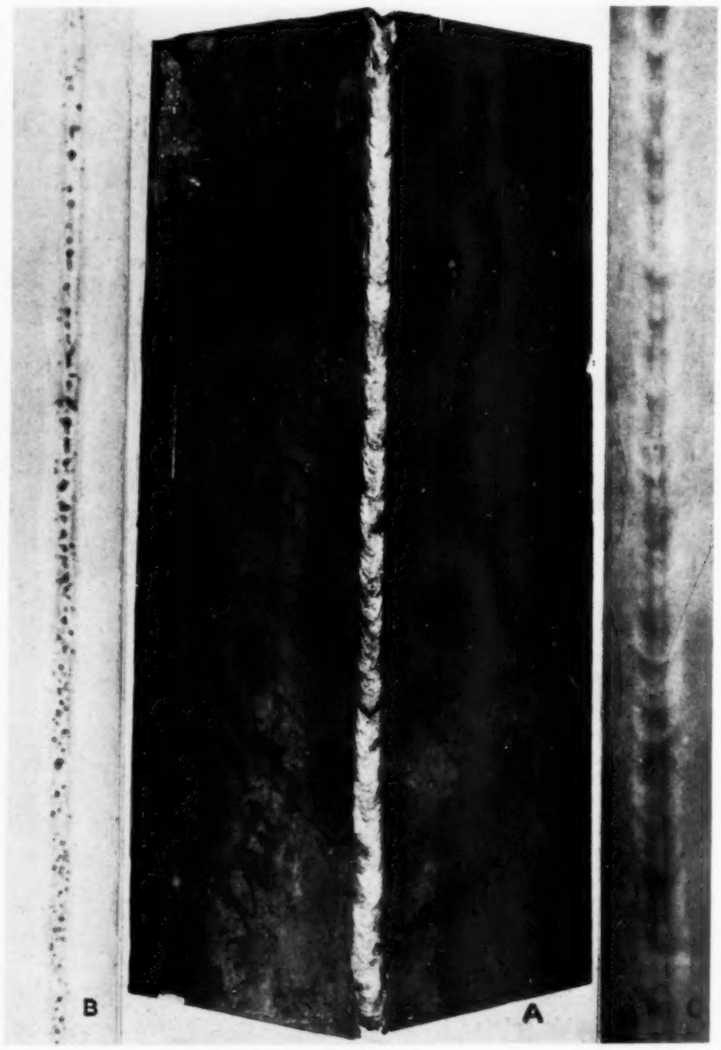


Fig. 1.

A. A photograph of a weld which judged by usual methods of visual inspection appeared to be a particularly good one. B. X-ray picture of the same weld. The black spots represent gas cavities. Under x-ray inspection the weld is seen to be a particularly poor one. In fact it was about the poorest weld made at the Watertown Arsenal. C. X-ray picture of weld in the same plate, using the same welding wire, but with a different current through the arc and using a different rate of feed. This weld from visual inspection seemed to be identical with that shown in A. It is quite different internally and represents a nearly perfect weld.

Fig. 1C shows this weld after development of a proper welding technique. In this one the plate and the welding rod are identical with that of Fig. 1B. Externally the welds were identical but internally there was a wide difference. This difference was brought about by a relatively slight change in the welding procedure.

Fig. 2 illustrates conditions found in a weld made by a commercial company supposedly representative of its best practice. This weld was also an excellent one judged by external appearance. The x-ray, however, showed it to be very porous and to contain a region where there had been incomplete penetration.

Fig. 3 illustrates a particularly bad weld.

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Here there is lack of fusion along one side as well as gas cavities in the center. This weld would not have passed visual inspection.

Fig. 4 shows a more typical condition. There was incomplete penetration although the weld appeared to be a very good one.

Fig. 2.

X-ray picture of a weld made in a commercial welding plant. A tensile test specimen has been taken out at the point where the vertical black line occurs. The black spots represent gas cavities. The black line at the right shows lack of penetration. This weld appeared to be a good one as judged by visual inspection.

Figs. 5A, 5B and 5C show three different orders of porosity. In 5A fairly large cavities show together with many very small ones that are not visible in the reproduction. 5B contained few large cavities but had numerous small ones. 5C looks like a clear weld. It is not though. It is honey-combed with minute cavities which show as faint marks in the negatives though which cannot be brought out in the print.

Where the bead is not ground off such welds as those shown in Fig. 5, especially in 5C, may have greater strength than the plate metal. There is a question as to how much porosity may be tolerated. Experimental data is lacking to determine the point. Then too it depends somewhat on the service required. Where steam-tight or oil-tight joints are needed it would be better to have no porosity at all.

Figure 6 shows a good weld.

IT is often required to determine how deep beneath the surface observed defects are situated. This may be determined approximately by means of a stereoscope. Such an instrument is illustrated in Fig. 8. Two negatives are made. Ordinarily the first exposure is taken and the x-ray bulb is moved 2½ inches, the distance between the eyes, in an horizontal direction to take the next one. The two negatives are mounted in the illuminating boxes and viewed through two 45° mirrors, one image is seen in the right and the other in the left eye. By manipulating the angle between the mirrors and by rotating them around a horizontal axis the two images are made to coincide and the observer sees the picture in three dimensions. It appears as a transparent plate of the thickness of the metal with black spots at different depths beneath the surface. Because the plate is thin the estimation of distances is not very accurate. We have found an ingenious method for overcoming this difficulty to a considerable extent. Instead of taking pictures with the bulb moved 2½ inches, we take them with a distance of 10 inches between the two positions. As a result the stereoscope image has its depth dimension greatly magnified. In a test of this effect the image of the weld in some ⅜-inch plate appeared to be about 2 inches in thickness. The weld was close to ½-inch thick counting the beads. It appeared that the thickness had been magnified by a factor of four. It was quite easy to locate the black spots fairly accurately.

Fig. 3.

A particularly bad weld. The current and lengths of arc varied and the feed was not uniform. This weld probably would have failed to pass visual inspection.

IN working with the improvement of welds the question comes up insistently, what causes cavities? The x-ray pictures give a clue to the answer. Fig. 7 is a typical picture of a group of gas cavities. There is very often a central spot on the film surrounded by a circle of spots of somewhat less intensity. Usually different circles of spots intersect as indeed they do in the present illustration, but careful study in most cases reveals the circular arrangement.

Very often the spots of the outer circle are elongated radially and sometimes terminate in pinholes at the surface of the metal. An example of this condition is shown in Fig. 9 which is a particularly gassy weld. Fig. 10 is a microphotograph showing a section through one of these elongated cavities. Adjacent to the cavity there is an envelope of metal, the structure of which is quite different from that a short distance away. Portions of this enveloping metal were examined at higher magnifications. A number of such cavities were examined, most of which showed a similar envelope, but some of them did not. There were numerous nitride needles and oxide inclusions throughout most of the weld metal.

The x-ray evidence together with that developed by the microscope seems to indicate that gas was in solution in the hot pool directly under the arc and that this gas was thrown out when the metal solidified. It did

Fig. 4.

This weld, of good appearance, contains gas cavities concentrated along the line of junction of the weld.

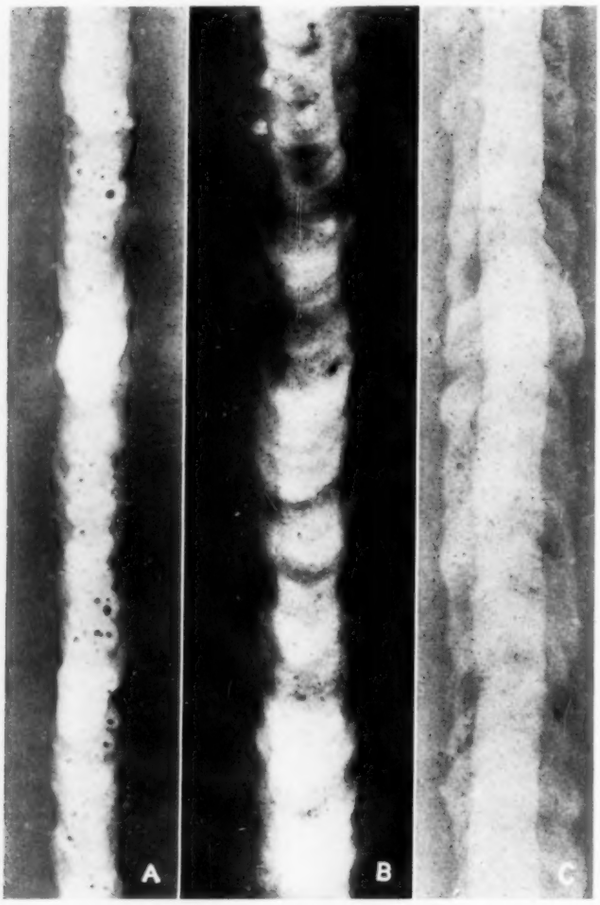


Fig. 5.

A, B and C represent three orders of porosity. A contains numerous cavities which were relatively large. B contains fewer of these but many small ones which do not show very well in the reproduction. C appears from the picture to be a good weld, but the negative showed many very small cavities which are lost entirely in the print.

not escape completely, much of it remaining to form small blow holes. The metal within the envelope seems to represent a region where the metal contains foreign elements in solution. In studies of oxides in steel, undertaken in connection with another investigation, similar structures to those represented by the envelope metal were encountered and were ascribed to the fact that the metal contained FeO in solution. It is suggested that a similar explanation holds in the present case. Segregated oxides were found at points remote from the cavities.

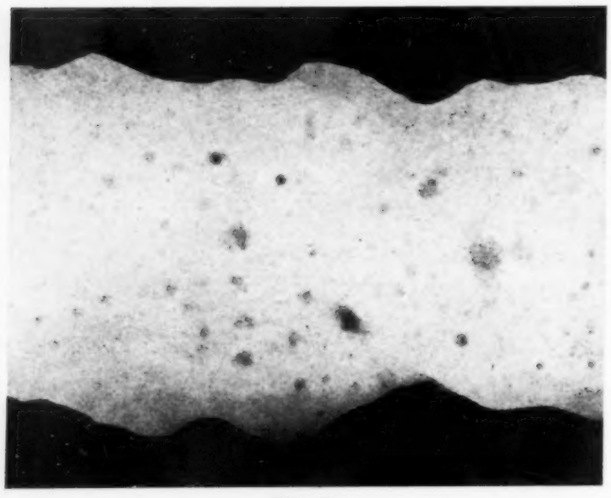


Fig. 7.

Typical arrangement of gas cavities in a defective weld. Usually the spots can be analyzed into systems with a central spot surrounded by an outer circle of spots.

X-ray tests show that porosity occurs when the current through the arc is too great or when the arc is too long. The arc probably in all cases carries considerable atmospheric gas into the weld, ionized oxygen and nitrogen for the most part. The escaping gas may be CO formed by a reduction of part of the carbon. Examination of some of the cavities indicated that the gas that formed them was reducing and not oxidizing.

X-ray results have been correlated with tensile, impact, and fatigue properties. It has been found that when the metal of the weld shows clear negatives these physical properties have their best values.

The above relationship is an important one. It indicates that the x-ray method offers an efficient and a sufficient inspection tool. The end in view in testing is the securing of dependable units of construction. This may be attained by elaborate inspection with rejection of bad welds. But such inspection is expensive and in many cases impractical or virtually impossible. A better method is to develop by x-ray control a technique that will give commercially perfect welds. This may be done.

Fig. 6.

A good weld. Very few defects may be found from the negative, but tiny cavities probably exist which could be detected if the weld were sectioned and examined with a microscope.

WHEN welding was taken up seriously at the Watertown Arsenal the question of soundness was considered to be of paramount importance. The Commanding Officer, Col. T. C. Dickson, stated that while such welds as that shown in Fig. 2 might be satisfactory for commercial work they would not do for gun carriages which must represent the last word in reliability. He decreed that the black spots must go. There followed a long period of experimentation. The current in the arc, the potential, the size and type of electrode, different electrode coatings and all other possible factors that could affect the weld were varied. At first the welds became worse instead of better, but eventually a combination of conditions was hit upon which gave almost complete absence of porosity. It was found that as long as the discovered procedure was followed good welds resulted, but even small deviations caused the spots to reappear. The welding foreman, to whom, by the way, the chief credit for this initial success is due, was very confident that he could reproduce the good welds indefinitely, given the same welding rod and

the same plate. He was instructed to make four top carriages for 3-inch antiaircraft guns. These were given a 100 per cent x-ray inspection and the welds in the production work proved to be as good as or better than those of the experimental development.

It took about four months to produce the first really good weld. But after the event it was realized that the factors which control correct technique are relatively few, simple and easily determined. Had we known as much in the beginning as we do now, the net result of the four months of discouraging labor could have been obtained in a few hours.

For any given plate to be joined there is a best type and size of electrode, an optimum current through the arc and a correct potential. The welder must be a man of sufficient experience, technical skill and reliability that he can be trusted to adhere to prescribed procedure.

Fig. 8.

The stereoscope. By using an abnormal angle in taking the two stereoscopic negatives the depth dimension in the picture is greatly increased permitting better estimation of depth.

In practice sample welds are made in scrap pieces of plate of the kind to be used in construction. These are x-rayed. Films of the preliminary welds are studied and the technique is modified in attempts to correct evident defects. As soon as the correct procedure is determined production is started. The foreman can tell pretty well from the sound of the arc, the current used, and the length of the arc whether serious deviations from prescribed practice occur. In addition check tests may be made at intervals. This has not been necessary at Watertown since gun carriages are given practically a 100 per cent final inspection. It is interesting to note in this respect that the final inspection pictures have not disclosed any important deviations from determined procedures.

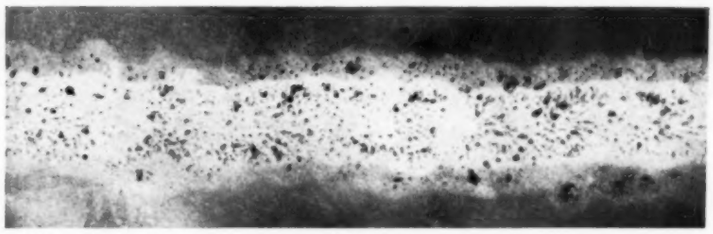


Fig. 9.

A particularly gassy weld. The spots are elongated and many of them terminated in pin holes at the surface. The broken section of this weld revealed the cavities. They are bright-walled indicating that the gas forming there was not oxidixing.

The welder, if he is a proper man for the job, reacts favorably to the x-ray control of procedure. He usually develops the technique. In doing so he is forced to think. The defects he sees pictured in the films are concrete understandable things. He becomes quite intimate with them in his struggle to overcome them. The job ceases to be a dull routine, it requires the exercise of his intelligence as well as his manual skill. The welding method for the particular job that results from his labor is a thing peculiarly his own. He guards it jealously. It is perhaps this fact that is responsible for the remarkable results which appear in the final tests, and which has been referred to above, that is, in the experience at Watertown Arsenal to date welds in production jobs are always equal to or superior to those developed in the experimental tests.

The achievements recorded above are of very great importance in welding, not only to the Ordnance Department but to industry in general. The application of x-ray tests to welds emphasizes a fact clearly demonstrated in the work with castings, namely, it seems to be more economical to use the method to train the artisan and to guide him in the production of perfect work than it is to use it to condemn bad work.

The success of the x-ray tests in their application to welding as was the case when they were applied to steel castings has been in no small measure due to the broad vision and keen interest of Colonel Dickson. He has taken the results of the tests seriously, and has insisted that others in the organization do the same. Without support from the top of the organization innovations in usual practice can never succeed. It is a pleasure to record that the x-ray testing at the Watertown Arsenal has always enjoyed such support.

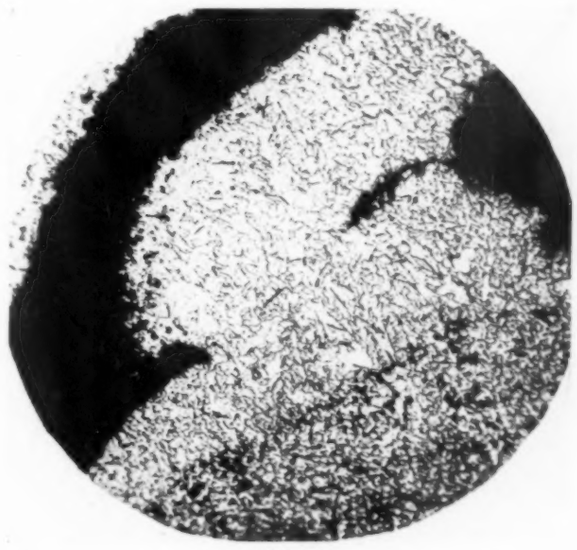


Fig. 10.

Microphotograph x 100 from weld shown in Fig. 9. Most of the cavities showed an adjacent border of metal of a different structure from that more remote. This picture shows the line of demarcation between the two types of structure.

The Evolution of the Sword

Types of Hand Weapons from Damocles to Date

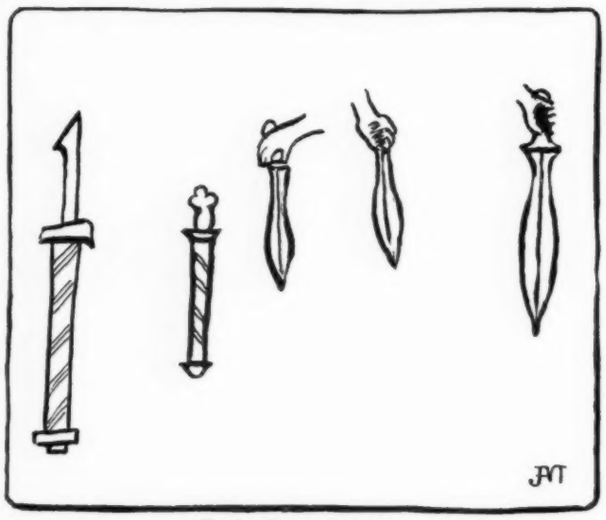
By J. A. Mountfort*

DAMOCLES, one of our earliest hot-air dispensers, used such extravagant language when he spoke of the unsullied happiness that is the lot of kings that Dionysius I, tyrant of Syracuse, resented it. By way of bringing home to the too talkative flatterer the fact that no one of us mortals is entirely and always happy, the king staged a banquet in honor of Damocles who was seated beneath a naked sword suspended by a single hair.

History fails to state whose hair suspended the sword but it is reasonable to suppose that Damocles' hair (if any) was standing straight. As for the sword itself, the word comes from an Indo-European root, meaning to wound, a general term used for any hand weapon of metal that is characterized by a longish blade. Thus the sword is distinct from all the missile weapons on the one hand, and the staff weapons, pike, bill, halberd and the like, in which the metal head or blade occupies only a fraction of the effective length.

The handle of a sword provides a grip for the hand that wields it, or, sometimes for the two hands. It may add protection, and in most patterns does to a greater or less extent, still, the handle is altogether subordinate to the blade. In olden times, for want of a metal-headed lance or axe (which were of a later invention), a sharpened pole or a thin-edged paddle served, but a sword without a blade is naught and no true blade can be made save of a metal capable of taking an edge or point.

Ordinarily a sword is four or five times longer than a dagger, but there are long daggers and short swords—the real difference lying in the intended use of the weapon. The sword is associated with open combat; the dagger with secret attack or sudden defense. One might say that any weapon too large to be concealed about the body could not be called a dagger. Then there are the large knives used by the Afghans, only distinguished from swords by the greater breadth of the blade as compared with the length. Again, there is the yataghan of the Mohammedans which really does not look much like a sword but still seems to belong to that class, as does also the Ghurka knife.

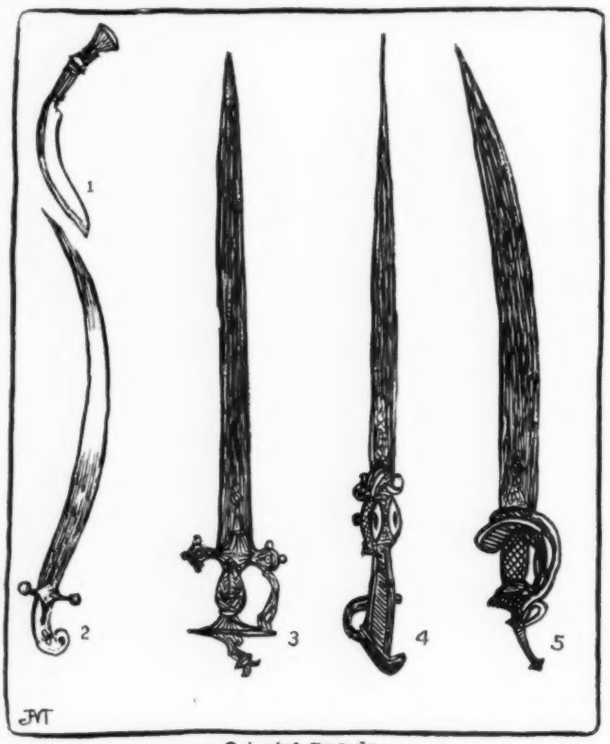


Early Greek Swords.

OF the actual origin of swords we know not. Daggers shaped from reindeer antlers occur among the earliest relics of man and there are flint daggers of the Neolithic period which may have been the models for the first hand weapons made of copper. Bronze took the place of copper about 2000 B. C., and the transition from bronze to iron is assigned to the period from 1000 to 700 B. C. Yet swords have been found dating back to the earliest times of which we have any record and among all the peoples who have ever acquired any skill at all in metal work.

There are two very ancient types, the straight edged and the leaf shaped. Assyrian monuments show a straight and narrow sword, better fitted for thrusting than for cutting and bronze swords of this form have been found, often side by side with leaf-shaped specimens. Bronze daggers preceded both swords and spear heads. The leaf shape is familiar to us from works of Greek art. These may have come from the flint daggers.

The Minoans used an overhead stabbing action, as the modern Asiatic dagger is used, and as the spear still was in historical times. Before 1500 B. C. the rapier



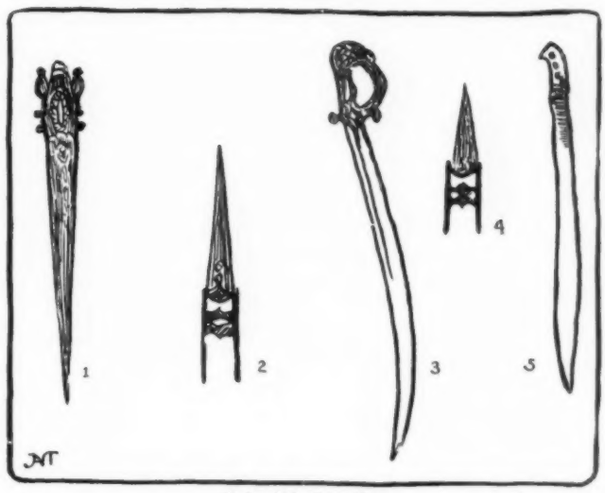
Oriental Swords.

1. Kukri (India); 2. Persian Talwar; 3 and 5. Decorated Persian; 4. Gauntlet.

*Mobile, Ala.

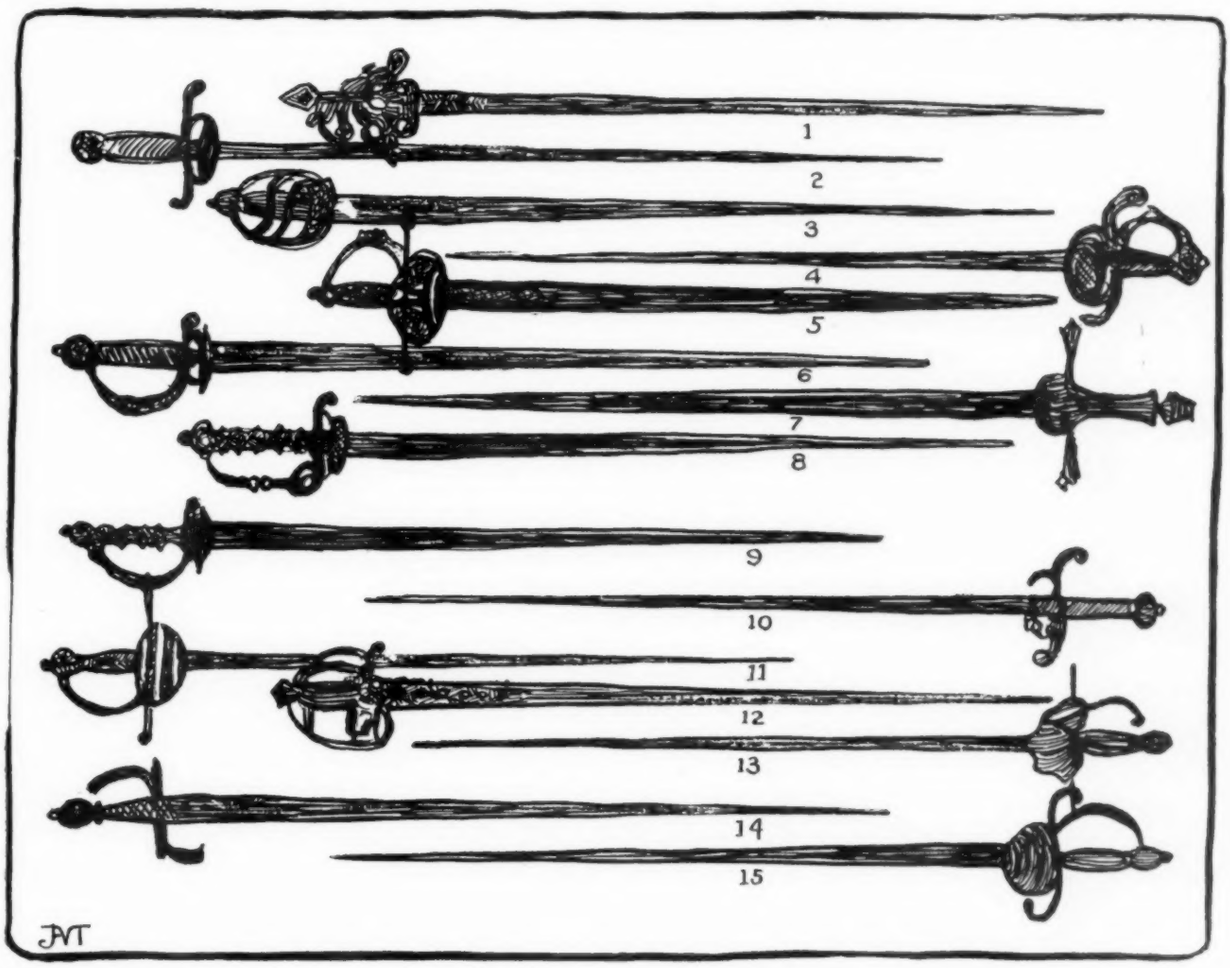
type prevailed. It is thought the leaf-shaped blade came to the Mediterranean countries from the north and was apparently used with a downright cutting blow, regardless of the consequent exposure of the swordsman's body, which would matter little when he had a shield or armor.

Use of the sword as combined offense and defense is quite modern. Obviously a development from the use of a spear-head dagger, it was a thrusting weapon before it was a cutting one. But in historical times the uncivilized peoples used only the edge and the effective use of the point was a mark of advanced skill and superior civilization. The Romans paid especial attention to it and Tacitus tells us how Agricola's legionaries made short work of the clumsy and pointless arms of the Britons.



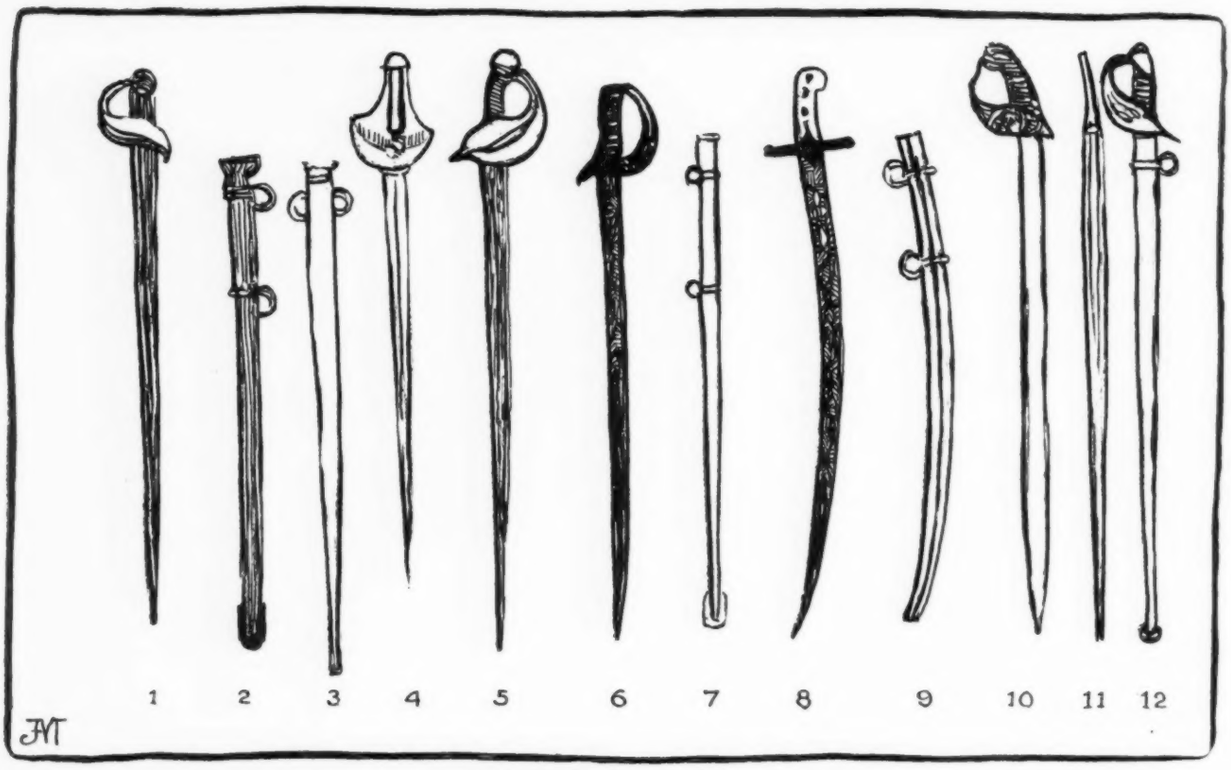
Oriental Swords.
1, 2 and 4. Mahratta (India); 3. Talwar (India); 5. Yataghan (Mohammedan).

Quite different from European models is the crescent-shaped Asiatic saber or scimitar, origin unknown. The fame of the Damascus manufacture of sword blades dates back a very long way, as does that of Khurasan, still the center of the best eastern work of this kind. Whoever first made these blades had evidently conceived a very definite idea, that of gaining a maximum of cutting power regardless of a lessening in other qualities, and executed it in a manner not to be improved upon. The action of the curved edge in delivering a blow is to present an oblique and therefore highly acute angled section of the blade to the object struck, so that, in effect the cut is given with a finer edge than could be put safely or with a maximum of



European Swords, XVI—XVIII Centuries.

1. Venetian (1550); 2. German Flamberg (17th Century); 3. English (Commonwealth); 4. Italian Rapier (16th Century); 5. Spanish Broadsword (17th Century); 6. Small Sword (1725); 7. German (1550); 8. French Rapier (1650); 9. Small Sword (1700); 10. Early 16th Century; 11. English (16th Century); 12. Italian (16th Century); 13. Spanish Rapier (16th Century); 14. English Musketeer's (17th Century); 15. Italian (16th Century)



Modern Military Swords.

1, 2 and 3. British Cavalry Sword and Scabbard (Officer); 4 and 5. British Cavalry Sword (men); 6 and 7. British Infantry Sword and Scabbard; 8 and 9. British Sword and Scabbard (General Officer); 10. German; 11 and 12. French Cavalry Sword.

efficiency on the blade in its direct transverse section.

In a well made saber the setting of the blade with regard to the handle (leading forward) is likewise ordered with a view to this result. The cutting power of a weapon so shaped and mounted is undoubtedly very great but the use of the point is abandoned and its defensive use diminished. Indian and Persian swords are often richly adorned but their appropriate beauty is in the texture of the steel itself, the "damascening" or "watering" which distinguishes a superior from a common specimen.

The modern short, sword bayonet is a reversion to the original dagger type. The double curve of the yataghan is substantially identical with that of the Gurka knife (kukri) though the latter is so much broader as to be more like a woodsman's than a soldier's instrument.

Then there are the swords of Japan, a highly perfected working out of a general Indo-Chinese type, powerful and often beautiful, but a European would find them ill-balanced, the Japanese two-handed style of sword play being quite different.

The Mahrattas in the south of India and the Sikhs and Rajputs in the north have a straight, gauntlet hilted sword, an elongated form of the broad bladed dagger, with a cross bar handle, with a guard for the back of the hand.

During the 16th century the straight, two-edged sword of all work was lengthened, narrowed and more finely pointed until it became the Italian and Spanish rapier. The Roman preference for the point was rediscovered and fencing became an art. Meanwhile a stouter and broader pattern was used for military purposes.

The name of Ferrara, of Scottish blades, appears to have belonged originally to a Venetian family of sword makers. Toledo's blades acquired a renown that still continues.

The Schlager is the specialized variety with which the German students fight their duels, generally merely a trial of skill under highly conventional rules causing much effusion of blood but rarely endangering life or limb.

The marked superiority of the Turks in battle was attributed to their curved scimitars when, in reality, probably it should have been laid to their dash and superb horsemanship. The purpose of the sword should determine its shape —for cutting a curved blade, for thrusting a straight, pointed one. A determined thrust, by a horseman at full speed, is difficult to parry. If it gets home it will probably kill the recipient or at least put him out of business. On the other hand, to deliver a bold thrust while disregarding the uplifted sword of the enemy, and leaving one's own body and head open to an impending blow, demands complete confidence that the blow will get home before the other's will descend. Such confidence can be but the fruit of long training, especially as it is the tendency of all men to cut when excited, and as the trooper will often be a reservist who has not kept up his swordsmanship, or a young soldier liable to lose his head, it seems wise to have a sword that will deliver a powerful cut.

A really good sword should be elastic, capable of a heavy blow, and a powerful thrust, without breaking or yielding too much from the straight. It must also be light and well balanced. It may be all four if made of suitable steel, properly treated. Grooving or fullering the flats of the blade reduces weight without impairing strength and is largely adopted.

It is a question which one Damocles might choose to sit under.

Industrial Intelligence Service

A World Clearing Agency for Invention

By M. D. Sydney Peterson*

CONSIDERABLE interest attaches to the establishment in New York of an international clearing house for invention. It is common knowledge that the absence of an adequate agency of this character has imposed a serious hardship on free-lance inventors and proponents of new ideas generally, who by and large have been at a loss as to how to proceed with the commercialization of new things. In consequence new products of merit have frequently been left to inept and unorganized direction with resultant retardation or ultimate failure of the business.

Of particular interest perhaps is the fact that the organization which has undertaken the performance of this important service brings to the undertaking an unusual experience in the field of new things. During the past seven years the banking firm of Campbell, Peterson and Company, Inc., of New York, has been engaged in a specialized way in the examination, selection, financing and development of new industrial projects. In the course of this experience it has become apparent that while new products and processes of outstanding merit sometimes justify by their distinctness the incorporation of a separate company, more often they call for absorption by established manufacturing concerns.

This consideration, together with the fact that the organizing company was the means of placing in recent years several interesting products to the distinct benefit of the companies involved, prompted the organization of the present clearing service which is known as an Industrial Intelligence Service.

Briefly, this service represents the projection on a world scale of a specialized clearing agency for invention.

THE affiliations and contacts developed during the past seven years of experience in the field of new things will of course be of great value in this extension of operations. They include banks, other financial houses, engineers, industrial engineers, corporation attorneys, patent attorneys, finding brokers, manufacturing and trade associations, chambers of commerce, business and industrial periodicals, capitalists, and inventors in every field. Such connections are being rapidly extended also with the widening scope of the company's activity.

Indeed, during this period many thousands of new business proposals, the majority of them involving a new product or process, have come unsolicited into this developing clearing house from an increasing area of contacts. The number has included some outstanding developments in industry. Companies have been organized to commercialize such inventions and are now in operation in the fields of heat control, liquid measurement, aviation, office appliances, and domestic electrical products—besides products and processes that have been placed with going industrial concerns. This record is indicative of the breadth of the connections that have been made during these years of the company's experience.

Important foreign affiliations have been established recently that give a world-wide scope to this enterprise. An affiliated house has been established in Paris to cover western Europe and to open systematically to American industrial clients of the company that fertile field of invention. This house is under the direction of Hart O. Berg, who has been well known for many years in connection with the transfer of industrial ideas, processes, and products between Europe and America. Through the establishment of this affiliated organization the intelligent introduction to American industry of much that is worthwhile in the industrial thought and practice of Europe is believed to be assured.

Another important foreign affiliation is with a German house backed by leading industrialists of that country and represented in the principal industrial centers of central and eastern Europe. Its resources and activities, it is expected, will make available the best of industrial developments in that wide area for commercialization in America.

Other connections involve the coverage of other foreign areas, including active representation in the most important non-European industrial countries. The inventor or proponent of a new industrial idea or process or product will thus find at hand, and will know that he does have at hand, the sort of opportunity for American utilization of his idea that has long been needed—the establishment of which indeed marks a forward step in industrial economy.

THE intelligent and efficient commercialization of the products of American and foreign invention—whether they come from the free-lance inventor, the research laboratory, or the experience of plant operation—involves the provision of capital and management. In a few cases this may best be done through the organization of a separate company and the development of a self-sustaining industrial concern. But probably 90 per cent of such separate incorporations are uneconomical, and the ideas, processes or products involved ought to have been commercialized through already established manufacturing companies and sales organizations. Coöperation and combination rather than the multiplication of individualism are a requirement of modern industrial advancement.

Not only in the search for and sifting of worthwhile new ideas and things in industry, but also in the intelligent commercial placement of them, is an intermediary operating on an international basis needed—between the inventor or proponent on the one hand, wanting capital and management, and on the other hand the industrial concern or group which may provide most effectively the capital and management needed. The organization of facilities for this purpose brings order out of chaos in this phase of industrial progress. The method of placement provided by Industrial Intelligence Service may be briefly explained.

*President, Campbell, Peterson and Company, Inc., New York, N. Y.

This organization has a group of clients which includes some of the leading manufacturing and distributing concerns in various fields and is adding to this number so as to round it out into a fair coverage of American industry. These concerns are non-competitive, as far as can be arranged, in main lines. They are chosen with a view to their ability to absorb important ideas, processes and products advantageously in their respective fields. Obviously a forward-looking attitude and policy on their part is essential. Eternal vigilance—a watch for what may be "around the corner"—and capacity for adjustment are qualities that are required anyway of business management in this age of accelerated change.

For these clients Industrial Intelligence Service through the agencies and affiliations that have been mentioned, makes continuous and systematic search for ideas, processes and products of present or potential concern or utility. There is opened to them also access to whatever comes unsought into this world-wide clearing house of invention. The investigating department of the company sifts carefully whatever is thus found or received, provides intelligent information about what is in its judgment worthwhile, and serves both proponent and industrial client as intelligently and fairly as its long experience and mutual interest enables it to do in such negotiation as may result.

If within its circle of clients there is no interest in a proposal thus submitted and regarded as valuable, it may take such a proposal outside. Or, if the proposal is clearly adapted to a separate development, provision is made in contract with clients for a limited number of such separate incorporations, with participation offered clients.

Clients also have opportunities through association in this enterprise, for interchange of ideas or methods or processes—or for outside leasing or sale of them.

The organization derives its profit in its operations as intermediary between proponents and manufacturers, from a small fixed percentage of the consideration arranged in successful negotiations rather than from the service fee charged. Its profit is proportionate, therefore, to the service it may render the clients who employ the company and provide the means for its world-wide activity.

The organization of facilities by which the free-lance inventor, or the proponent of new ideas from any source, has at hand a clearing house where he may confidently submit his contribution to industrial progress—and a large measure of our industrial progress has come from the free-lance inventor—is a development of unusual significance to American industry. So, too, is the association of a group of important manufacturers as clients of this house. Its experience and connections have qualified it to extend its operations in this way, and the coöperation of manufacturers of this sort makes possible to an enterprise of such world-wide scope.

The Board of Directors of Campbell, Peterson and Company, Inc., includes Harry A. Arthur, President of Allied Machinery Company of America; F. T. Bedford, President of Penick and Ford, Limited, Inc.; Matthew C. Brush, President of American International Corporation; R. Potter Campbell, Chairman of the Board of Campbell, Peterson and Company, Inc.; John J. Cone, President, Robert W. Hunt & Company; William M. Flook, President and Chairman of the Board, American Brown Boveri Electric Corporation; William S. Gray, Jr., Vice-President Central Hanover Bank and Trust Company; George E. Hardy, formerly Chairman of the Board, Commonwealth Power Corp.; Walter F. Hobbs, Industrial Engineer; Stephen T. Kelsey, Asst. Vice-President, Title Guarantee and Trust Co.; Frank Little, First Vice-President of the Company; Charles O. Miller, Secretary-Treasurer of the Company; Charles W. Peelle, President, The Peelle Company; M. D. Sydney Peterson, President of Campbell, Peterson and Company, Inc.; Orlando B. Willcox, Member of Choate, Larocque and Mitchell, Attorneys.

It is felt that inventors will be interested to learn of this novel clearing house for industrial intelligence. Already recognized in the American metropolis as an established organization whose effort is concentrated in the field of new things, its unique service will, no doubt, accord it similar recognition throughout the country.

During the British Championship Rifle Matches at Bisley; Firing the Counties Championship, July 7, 1930.

ARMY ORDNANCE

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Month by Month

The Retirement of General Ruggles

IT is with keen regret that we chronicle the retirement of Brig. Gen. C. L'H. Ruggles, Ord. Dept., U. S. Army, Assistant to the Chief of Ordnance and head of the Manufacturing Service of the Ordnance Department who, after 44 years of noteworthy accomplishment, retired from active service August 31, 1930. General Ruggles is an international authority on certain ordnance subjects. His indefatigable application to every duty of the many important positions he occupied during his long military career, his kindly manner and his keen analytic approach to the complex problems of ordnance mark him as an outstanding officer who contributed in full measure to the munitions progress of the national defense.

General Ruggles was born in Omaha, Nebraska, March 18, 1869, and was appointed to the United States Military Academy by the President, at large, in 1886. He was graduated from the Academy, ranking fifth in his class, and though recommended by the academic board for promotion in the Corps of Engineers, was commissioned in the Artillery. He served with the 1st Artillery as additional second lieutenant and with the 3rd Artillery. As a result of winning a competitive examination of lieutenants of the line, he was transferred to the Ordnance Department as first lieutenant on December 18, 1893.

After transfer to the Ordnance Department, he served at the Sandy Hook Proving Ground and at Frankford Arsenal until 1899. While on duty at the latter establishment he developed a new primer for small arms ammunition. This primer contained no fulminate of mercury which had been found to cause the splitting of brass cartridge cases in storage after firing. It was adopted by the Army and was continued in use until after the World War. In 1899 he was given independent duty as inspector of ordnance at the Bethlehem Steel Works, South Bethlehem, Pa. His duties included the inspection of guns, gun forgings and castings, gun carriages and projectiles, of all calibers up to and including 12-inch. While at the Bethlehem Steel Works, in addition to his other work, he attended the Lehigh University, from which institution he was graduated with the degree of electrical engineer.

From July, 1903, to August, 1908, General Ruggles was stationed at the Watertown Arsenal and for eight months of this time he was in command of the arsenal. He installed the first steel-making plant at the arsenal, and while in command started the school for officers which has continued there up to the present time.

In August, 1908, he was detailed to the United States Military Academy as Professor of Ordnance and Science of Gunnery with the rank of lieutenant colonel. During his tour of duty at the Academy, he inaugurated the course in practical shop work for cadets and wrote the text book entitled "Stresses in Wire-Wrapped Guns and in Gun-Carriages," which is still in use at the Academy.

General Ruggles as lieutenant colonel, was commanding officer of Benicia Arsenal and ordnance officer of the Department of California, 1911-1913, and commanding officer of the Manila Ordnance Depot and ordnance officer of the Philippine Department, 1913-1915. Upon his return to the United States in November, 1915, he was assigned as commanding officer of the Sandy Hook Proving Ground and President of the Ordnance Board. While in command of that station he made plans for and selected the site for a larger proving ground which the department foresaw would be needed in the event of war, and in accordance with these plans he constructed the Aberdeen Proving Ground during the World War and commanded it, in addition to the Sandy Hook Proving Ground, until March 3, 1918, when he was detailed first chief of the Supply Division, Office of the Chief of Ordnance, and shortly thereafter chief of the Inspection Division. As chief of that important division, General Ruggles was responsible for the quality of all ordnance made for the Army of the United States in this country and in Canada. The Inspection Division comprised at its maximum over 1,000 officers and 30,000 civilians. He was made a temporary brigadier general August 8, 1918. While chief of the Inspection Division he was ordered overseas in October, 1918, on temporary duty to establish an overseas liaison with the British and French ordnance inspection services and to inspect the artillery matériel of the American Expeditionary Forces. He was recalled from France after the Armistice to organize the Technical Staff of the Ordnance Department of which he had been appointed chief.

He was chief of the Technical Staff, from the time of its organization until August, 1921, when he was detailed as a student at the Army War College. After graduating from that institution in 1922 he was again detailed as chief of the Technical Staff. While serving in that capacity he organized, in 1919, the present technical committee, known as the Ordnance Committee.

General Ruggles was appointed assistant to the Chief of Ordnance with the rank of brigadier general March 28, 1923. He was appointed chief of manufacture, Ordnance Department, on July 12, 1923, and in that capacity had control of all the ordnance manufacturing arsenals and was in charge of all the designing and procurement functions of the department. He was also charged with the development of plans for industrial mobilization so far as such plans pertain to ordnance matériel. His services have resulted in marked advance in the plans for the procurement of ordnance supplies in case of a major emergency. He was appointed by the President a delegate of the United

States to the Convention for the Supervision of International Trade in Arms and Ammunition and in Implements of War, held at Geneva, Switzerland, May 4 to June 18, 1925. He was reappointed assistant to the Chief of Ordnance, March 28, 1927.

General Ruggles is a charter member of the Army Ordnance Association and a member of the American Society of Automotive Engineers and the American Society of Mechanical Engineers. He is a member of the Loyal Legion, by inheritance; also a member of the American Legion. He received the Distinguished Service Medal in recognition of his services in the planning and construction of the Aberdeen Proving Ground during the World War with the following citation:

"For exceptionally meritorious and distinguished service. The conception and construction of the Aberdeen Proving Ground and its operation during the early and most difficult period of its history are a monument to his sagacity and unremitting labor."

Members of the Army Ordnance Association will recall with pleasure and appreciation the many courtesies extended them by General Ruggles. He addressed their local and national meetings on innumerable occasions, always inspiring his hearers with his profound knowledge, broad viewpoint and intense devotion particularly toward industrial preparedness, a subject upon which he was without peer.

To him in his well-earned surcease of duty we extend every happy felicitation. In his years of retirement—may they be many happy years freighted with the supreme satisfaction of an active life of true patriotic performance—the esteem of his countless friends and the constant good wishes of all advocates of munitions preparedness will follow him always. In the annals of the science of ordnance his contributions place him with Woodbridge, Longridge and Brunel; in the broader aspects of the munitions problem he stands high in the list of notable Americans who have helped and are helping to bridge the gap between industry in peace and industry in war.

ON August 18th the President approved the appointment of Col. Edwin D. Bricker, Ord. Dept., U. S. A., to be Assistant Chief of Ordnance with the rank of brigadier general to succeed General Ruggles.

General Bricker, Assistant Chief of Ordnance

Born at Chambersburg, Pa., General Bricker was appointed to the U. S. Military Academy in June, 1894, and was graduated in 1898. His first service was as second lieutenant of the 17th U. S. Infantry with which organization he accompanied the expedition against Santiago, Cuba, at the outset of the Spanish-American War. During that conflict he participated in the engagement at El Caney on July 1, 1898, and in subsequent engagements with the Second Division, 5th Army Corps in the operations about Santiago until its surrender July 17th of the same year.

As a first lieutenant of Infantry he served in the Philippine Islands during the advance of the Second Division, 8th Army Corps, from Manila to Dagupan, and also participated in the actions at San Luis, May 17, 1899; attacks on and actions about San Fernando de Pampanga, May 27 to June 20; actions about Angeles, October; engagements during the advance from Angeles to Magalang, November 5th, and the advance from Mabalocat to Copas, November 11, 1899.

General Bricker was commissioned a first lieutenant in the Ordnance Department January 3, 1901, and served at the Manila Ordnance Depot until April of that year when he was transferred to the Rock Island Arsenal. Subsequently his tours of duty included Sandy Hook Proving Ground, August 1903 to June 1906; Inspector of Ordnance at Sharon, Pa., July 1906 to January 1908; Rock Island Arsenal, February 1908 to October 1910; Watervliet Arsenal, October 1910 to February 1915; Frankford Arsenal, March 1915 to June 1917; Office of the Chief of Ordnance, Washington, D. C., June to September, 1917. During this time he was promoted to captain, January 21, 1904; major, January 21, 1909, and lieutenant colonel May 15, 1917.

During the World War General Bricker was on duty with the American Expeditionary Forces in France as Chief Purchasing Officer for the Ordnance Department, serving in that capacity from October 19, 1917 to August 14, 1919, in the grades of lieutenant colonel, until January 14, 1918, and as colonel from that date. He served as Chief Ordnance Officer, American Forces in France, August 15 to November 15, 1919. Upon his return to the United States he was on duty in the Office of the Chief of Ordnance as Chief of the Administration Division, November 26, 1919 to November 24, 1920, and as Executive Assistant to Maj. Gen. C. C. Williams, Chief of Ordnance, from November 24, 1920 to August 21, 1922.

General Bricker's next duty was as a student officer at the Army War College, Washington, D. C., from which he was graduated August 21, 1923. He then became Commanding Officer of the Watervliet Arsenal, where he served from October 1, 1923 to July 30, 1929. He became Chief of the Technical Staff, Office of the Chief of Ordnance, August 1, 1929, which important position he held at the time of his recent promotion. It is understood that General Bricker will be Chief of Field Service of the Ordnance Department, the office previously held by Maj. Gen. Samuel Hof until his appointment as Chief of Ordnance. Brig. Gen. William H. Tschappat, whose promotion was announced in the last issue of ARMY ORDNANCE, is now Chief of the Manufacturing Service vice General Ruggles.

General Bricker received two citations for gallantry in action in connection with his service during the Spanish-American War and wears the Distinguished Service Medal for his World War activities.

The citation accompanying the Distinguished Service Medal reads: "Edwin D. Bricker, colonel, Ordnance Department, National Army. For exceptionally meritorious and distinguished services. As Chief Ordnance Purchasing Officer and later as ordnance representative on the General Purchasing Board, he conducted negotiations with marked success for material needed to supplement the supply from the United States. He worked tirelessly and with unflagging energy to the end that there would be no shortage in supplies sent to the troops at the front. At all times exercising sound judgment and discernment in times of emergency, he achieved marked successes."

ARMY ORDNANCE joins General Bricker's many friends in extending congratulations on his well-merited promotion and in offering every good wish for his success.

Our Annual Meeting

FROM the general announcements appearing on pages 101 to 104 of this issue of ARMY ORNNANCE, it will be noted that a very pretentious program has been outlined for the sessions of the Twelfth Annual Meeting of the Association on October 8 and 9. The principal departure from previous years is that the business and technical meeting of the Association formerly held at the Proving Ground will this year take place in Washington, D. C., on the evening of October 8th. The annual meeting of the Ordnance Districts Chiefs which is scheduled to be held in Washington on that day will, we hope, make available for our evening session a full attendance of this distinguished group.

The program of addresses including the Assistant Secretary of War, Hon. Frederick H. Payne, and Mr. Ernest T. Trigg, Chairman of the Committee on National Defense of the U. S. Chamber of Commerce, which committee also will be in session in Washington at that time, is a fair criterion of the prominent civilian component which will be present. This will be the first opportunity for members of the Association formally to greet the new Chief of Ordnance, Maj. Gen. Samuel Hof, and his two assistants, Brigadier Generals William H. Tschappat and Edwin D. Bricker. General Tschappat will present the technical discussion of the session in an illustrated talk on recent ordnance developments.

The highlight of the session will be the foundation and first award of the Williams Gold Medal for Distinguished Ordnance Service. General Williams, of course, will be present to receive the award and needless to say many of his friends and admirers will want to be on hand to witness it.

The program of current tests for the Aberdeen session bids fair to exceed in interest those of previous years. The Chief of Ordnance and his assistants, the Commanding Officer of the Proving Ground and his staff and many Chiefs of Branches of the Army are coöperating in the presentation of a program especially intended to emphasize the industrial features of ordnance design and manufacture for the executives and engineers of the Army Ordnance Association and their guests.

Waldo C. Bryant

THE Army Ordnance Association announces with regret the death on July 5, 1930, of Mr. Waldo C. Bryant, one of the founders of the organization and a member of its Board of Directors since 1919.

Mr. Bryant was born at Winchendon, Mass., December 17, 1863. He attended the Worcester Polytechnic Institute from which he was graduated with the degree of B. S. in 1884. He began his professional career as an electrical engineer with Thomson-Houston Electrical Company, Lynn, Mass., in the same year. Subsequently he became assistant superintendent of the Bridgeport Electric Light Company, and in 1886 superintendent of the Waterbury Electric Light Company. In 1889 he founded the Bryant Electric Company of Bridgeport and served as president, treasurer and general manager. At the time of his death he was chairman of the board of directors of that company. He was also president and treasurer of the Perkins Electric Switch Mfg. Co., first vice-president of the Peoples Savings Bank, vice-president of Bead Chain Manufacturing Co., director of the Bridgeport Brass Company, Bridgeport Hydraulic Company, First National Bank of Bridgeport, The Simeon Company, Bridgeport Hospital, Bridgeport Public Library, Bridgeport Boys Club, and a member of the American Institute of Electrical Engineers.

In February 1918, Mr. Bryant entered the service of the War Department as Ordnance District Chief for the territory embracing the state of Connecticut and four counties in western Massachusetts, where he had charge of the production and procurement of munitions in that area. He was active in the organization of the Army Ordnance Association in 1919 and his interest and coöoperation, which continued through the intervening years, was of material benefit to the organization.

ARMY ORDNANCE conveys its sympathy to the family and friends of Mr. Bryant who pioneered so nobly in the days when industrial preparedness was in great need of the few staunch and sympathetic friends who launched it.

Aberdeen's Place in the Sun

THE annual pilgrimage to Aberdeen to be made in connection with the Twelfth Annual Meeting of the Association on October 9th again serves to focus attention on one of the most important and certainly the most unique ordnance establishments the world over. Col. E. M. Shinkle in the leading article of this issue discusses some of the more important scientific developments which have been carried on under his splendid administration at the proving ground during recent months. Oftentimes in observing the technical and engineering activities of Aberdeen one is prone to forget the tremendous responsibility and organizational activities attached to the operation of such an important post as this.

A proving ground, as its name indicates, is essentially a laboratory for determining data in regard to matériel sent to it for test, but due in part to its convenient location, in part to the great variety of types of ordnance matériel available, and to the size of the reservation, many other activities have developed at Aberdeen in the course of years. These activities, not part of a proving ground proper but on the same reservation, must be administered and controlled by the same staff, and to that extent add to its burden.

The Aberdeen Ordnance Depot has a storage capacity of 463,000 square feet. In this depot and on gun racks and railroad trackage, not under cover, is stored ordnance matériel to the value of approximately $55,000,000, and there are now under construction sixteen magazines of the newest Navy igloo type, which will be filled, when completed, with stocks of ammunition not for use at the proving ground.

For several years past annual antiaircraft exercises for the intensive test of newly developed antiaircraft matériel, including fire-control instruments, have been held at the proving ground. These annual antiaircraft exercises have aided greatly in the rapid development of antiaircraft matériel and have taken the place of the usual service test of new matériel. The Aberdeen Proving Ground garrison normally consists of about 30 officers and 200 enlisted men in addition to the civilian force, but during the past year the military personnel has probably averaged 700, with a maximum of nearly 1,400.

The Williams Medal for Distinguished Ordnance Service

An Editorial

AS announced elsewhere in this issue of ARMY ORDNANCE, the Association has founded in honor of Maj. Gen. C. C. Williams, U. S. Army, Ret., formerly Chief of Ordnance, a gold medal to be known as the Williams Medal for Distinguished Ordnance Service. The institution of the award and its first bestowal upon the distinguished soldier and leader whose name it bears will be made by the President of the Association at the business and technical session of the Twelfth Annual Meeting to be held in Washington, D. C., on the evening of Wednesday, October 8, 1930, preceding the scientific session to be held at the Aberdeen Proving Ground, Md., on the following day, Thursday, October 9th. The entire roster of Trustees and Directors of the Association composed the first Committee of Award and it was unanimous in the choice of General Williams. A word as to the significance of the foundation of the medal and the merit of its first recipient should be of special interest.

TO those of us who, by conviction, are firm in according transcendental importance to military armament in the social and economic guarantees of life, it is not necessary to go back to early beginnings and resurrect the wrought iron Mons Meg from its repose in Edinburgh Castle. Even though our present-day 4.7-inch gun has its caliber counterpart in "Queen Elizabeth's Pocket Pistol," our advancement from the days of built-up guns of iron bars and external rings to the weapons of machine war of today is a commentary on progress which speaks in even louder accents than the contrasting concussions of the ancient and modern pieces themselves. One can scan the periods in the evolution of land armament and in none of them will the progress be so strikingly apparent in every class of weapon as that which characterizes what we know as American Ordnance of the post-World War period. The one name and the one man to be identified in years to come as typifying that progress is General Williams. Not to perpetuate but to add a measure of tribute to that fact the Williams Medal is intended to take its place as one of the coveted awards of the nation to be won only for works of intrinsic distinction in the world of military armament.

The medal itself is the work of the well known sculptor, Mr. Rudd Freund, and is executed by the Bailey, Banks & Biddle Company of Philadelphia. On its obverse side is a likeness of General Williams in bas-relief with a superimposed inscription "Maj. Gen. C. C. Williams, Chief of Ordnance, U. S. Army, 1918-1930" and on the reverse side the panelled wording in relief with ordnance insignia, "Awarded by The Army Ordnance Association for Distinguished Ordnance Service to Maj. Gen. C. C. Williams, October, 1930." The medal is suspended from the Association colors. Subsequent awards will not be made at stated intervals. After the appointment of a permanent committee on award the medal will be bestowed whenever in the opinion of the committee it is merited by work of special distinction in the field of ordnance.

IT is no new thing for a nation-wide scientific society to honor one of its founders and leading figures through the foundation of a medal. Even less novel is the singling out of the same individual as its first recipient. The departure from everyday occurrence in this instance lies rather in the happy circumstance that the man and his work, both being worthy of the highest honor and distinction, are at hand in a field not hitherto acknowledged with honoraria of this kind. Thus the Williams Medal becomes a symbol for those who may do of what another has done. In its award hereafter—long after the duty to carry on has passed to other hands—when works of distinction in the restricted field of ordnance deserve it, there will arise in panorama the record of one who by innate ability led his fellows in war and peace in one of the most important tasks to confront a people. The Williams Medal will symbolize the fidelity, ability and loyalty which are essentials of success. To another generation it will recall an engineer of the military profession who at a critical period in the nation's history undertook the almost impossible task of producing munitions for an army of millions at home and overseas. It will reëcho the call and heroic response of American engineers and manufacturers to the production of ordnance. But equally important it will signify a period of post-war development during which almost every type of land armament for the American service was carried through the stages of painstaking development and brought to successful culmination. Indeed it will mark the beginnings of a new order, the pioneering in new fields, the origin of new concepts, the start of American ordnance of the twentieth century.

CONTINUED progress will demand the same viewpoint and application. The Ordnance Department of the Army under its present guidance will continue this unique advancement. But on its record the work of General Williams for American ordnance will remain a guide post on the highway to efficient national defense and the Williams Medal, we confidently hope, will stimulate and enliven among those to whom the torch is passed a constant devotion to the ideals of one who successfully led the way in a great undertaking.

Guns, carriages, rifles, cartridges, ammunition and explosives are things requiring constant research. Modernization of ordnance manufacturing processes and of the procedure of military supply are functions which must be kept abreast, if not ahead, of civilian practice. Industrial mobilization and general elucidation of the ever-changing munitions war plan to, what the Secretary of War very aptly has referred to as "the living body of industry, its customs, practices, organization and character,"—these are obligations of the first importance. To honor distinguished service in any or all of them is a duty which the Army Ordnance Association gladly accepts. To do so in the name of General Williams is to honor those who confer no less than him who receives for members of the Army Ordnance Association are themselves honored by this tribute.

Professional Notes

Christie Tank to be Purchased

WITH the approval of the Secretary of War, the Ordnance Department will purchase one high speed tank of the Christie type from the United States Wheel Track-Laying Corporation. The vehicle, scheduled for delivery during September, will be given a thorough technical and tactical test.

The general characteristics of the Christie vehicle are to be as follows: weight, not over 15 tons; engine, a Liberty as used in the Mark VIII tank; type, convertible wheel and track; required speed, 40 m. p. h. on wheels and 30 m. p. h. on tracks; crew, 2 men; armament, 1 37-mm. and 1 caliber .30 machine gun in combination mount in an all-around fire turret. The armor is to be proof against caliber .30 armor-piercing ammunition although the tank to be purchased for test will be equipped with soft steel plate of the same thickness as the proper armor plate.

The Naval Ammunition Depot at Hawthorne, Nev.

ON the western plains of Nevada, near the barren site of a deserted gold rush town, the Navy is completing construction of its newest "naval station." Here on a desert, 1,000 miles from the Pacific coast, a "town" known as the Naval Ammunition Depot, Hawthorne, Nev., will be commissioned by the Navy about September 30, 1930.

The Hawthorne reservation occupies 180 square miles of barren land, situated half-way between Reno and Goldfield. The reservation is on a gently sloping plain, 4,500 feet above sea level, bordered on the west by high mountains and on the north by Walker Lake, which is a remnant of a prehistoric inland sea. The nearest railroad line, prior to the building of the "town," was about 5½ miles away.

Construction was formally started July 24, 1928. A water supply was brought in from the mountains to the westward, where a 10,000,000-gallon reservoir has been constructed. Railroad tracks were laid to the site, highways built, electrical and steam systems established. High explosive magazines have been built, and, at some distance away, permanent quarters for the naval and civilian personnel who will inhabit the new town have been erected.

The project at Hawthorne has involved the construction of 145 permanent buildings, including high explosive magazines, mine-handling buildings, a laundry, a central heating and boiler plant, administration buildings, residences and barracks, a hospital, a school house, an auditorium and a fire engine house, together with repair shops, storehouse and refrigerating plant.

The work includes 8 miles of railroads, 24 miles of highways, 15 miles of fencing, 35,000 square yards of paving and sidewalks, a complete water supply system with 10,000,000-gallon dammed reservoir, a distributing reservoir and 10 miles of piping, and complete sewage disposal systems, underground steam and electrical systems, recreational facilities and extensive landscaping.

The residences and school are of brick, while the other buildings in the administration and industrial area, located about a mile from the south end of Walker Lake, are of concrete and artificial stone. The magazines are located in groups of seven. They are of the "igloo" type, partly below ground. The spacing of the magazines in each group and the distance between adjacent groups is sufficiently great to minimize the danger of "sympathetic" detonation of adjacent magazines in the event of an explosion of one magazine in a group, and to prevent the destruction of one group from affecting adjacent groups.

The Navy sought this site near Hawthorne for the storage of explosives in a region where the unfavorable conditions for human habitation and agricultural development would afford necessary isolation.

At the termination of the World War, the Navy was faced with the problem of storing a huge supply of munitions which was on hand or in transit to France. This vast quantity of ammunition, mines, depth charges and other explosives was stored temporarily in the existing depots, through force of necessity, although it was recognized that the overcrowding of the ammunition depots was undesirable from the standpoint of explosion hazard.

The disaster at the Naval Ammunition Depot, Lake Denmark, N. J., in July, 1926, emphasized the necessity of providing adequate and properly protected storage facilities for this great volume of ordnance material, and for the safe peace-time storage of war reserves of ammunition.

A board of Navy officers was appointed to study this problem and to formulate a definite policy with regard to ammunition storage standards. After an exhaustive investigation of the question, this board recommended that a naval ammunition depot be established to serve the Pacific coast, to be located within 1,000 miles of the coast, to be so situated as to have convenient railroad connections to the Los Angeles-San Diego area, the San Francisco Bay region and the Columbia River-Puget Sound area, and to be placed either on Government-owned or cheap barren land covering an area of at least 100 square miles.

In pursuance of this recommendation, naval experts inspected and investigated a number of sites in California, Utah and Nevada, and recommended that the depot be located near Hawthorne, Nev., on a tract of 180 square miles of barren land, mostly Government-owned, which was available practically without cost.

Excellent railroad connections to San Francisco and the Pacific Northwest already existed within comparatively easy reach, and the connection to Los Angeles, while of narrow gauge in part, eventually could be improved as a standard railroad.

Climatic and meteorological conditions were excellent, rainfall averaging less than three inches a year. The soil was well-drained and firm, and ample supplies of sand and gravel were available.

Walker Lake, 25 miles long and eight miles wide, was near at hand and, having no outlet, offered excellent possibilities for the recreational facilities which are requisite for the maintenance of morale in this isolated spot. The town of Hawthorne, formerly a busy mining center, but in recent years almost deserted, lay within the limits of the reservation but was not a part of it, while Thorne, where the branch lines to the station joined the Southern Pacific Railroad, was about five and one-half miles away. Reno, the largest city of Nevada, lay 150 miles to the northward.

The project for the ammunition depot was authorized on May 29, 1928, at a total cost not to exceed $3,500,000, and on July 24, 1928, the work was formally started by the Hon. Fred Balzer, Governor of Nevada, in the presence of over 4,000 visitors, including many prominent citizens and several high ranking naval officers. Lt. Comdr. Carl H. Cotter, Civil Engineer Corps, United States Navy, who had been ordered as officer in charge of construction, began active work immediately in the development of plans for the station.

Topographic surveys were completed by the Geological Survey Division of the Department of the Interior on September 11, 1928, and by December 15, 1929, negotiations for the purchase of the private tracts needed for the reservation were completed.

Contracts for the railroads, highways and electric transmission lines were awarded in rapid succession, and were followed by the contract for the main buildings and water supply system. Numerous other contracts were let as rapidly as plans could be prepared, the total awards to date being approximately $2,900,000. The principal items yet to be done include the Cat Creek dam, the mine-filling plant, and the landscaping and general improvements of grounds.

It is anticipated that the station will be ready for occupancy by September 30, 1930, and that transfer of ordnance material will be undertaken immediately. When completed, this modern scientifically designed ammunition storage depot, it is said, will be the safest plant of its kind in existence, and will be a vital factor and an invaluable adjunct in connection with the national defense in the Pacific area.

Inspection of Sea Coast Guns

AT present many of the seacoast fortifications of the country are in the hands of caretaking detachments of Coast Artillery troops employed in keeping the armament and matériel in condition for service. Unlike some kinds of matériel seacoast armament and equipment, as pointed out by Maj. Gen. John W. Gulick, Chief of the Coast Artillery Corps, cannot be removed to places of covered storage but must be cared for at their permanent location. Although the Coast Artillery is provided with many railway and other mobile guns, a great part of its armament consists of guns and establishments permanently emplaced in the position where they will be needed in time of emergency. Their movement would be undesirable even if practicable.

Many of the important as well as the less important fortifications are now in the hands of small caretaking detachments who keep the guns in condition and protect them against the inroads of rust and deterioration. These detachments are of an average strength of two commissioned officers and twenty-five enlisted men. Their work is monotonous but generally well done.

Since the Regular Army Coast Artillery is not sufficient to man all the coast defense guns, dependence will be placed on the National Guard who upon the outbreak of hostilities would immediately man them. During the annual two weeks of field duty many National Guard units man the batteries to which they would be assigned in time of war and thereby become familiar with the equipment which they are to handle. This requires that the caretakers be faithful and industrious in the performance of their duties since the authorized strength of the entire Coast Artillery Corps is not sufficient to detail but a few men on this duty.

The importance of this duty to the taxpayers of the country may be fully appreciated when it is realized that the United States has spent $250,000,000 on the present seacoast fortifications. The identical fortifications could not be replaced today for less than $400,000,000.

The fortifications out of commission are by no means obsolete and useless. In the future aviation may have some effect on the coast defense guns but since the military use of aviation is still in process of development its exact effect has not been definitely determined to the satisfaction of the War Department up to the present time. Big guns are still an important factor in the protection of our seacoast. Some of the present guns are newer than others but none now emplaced are obsolete. Some are of longer range than others of the same caliber but no seacoast guns are useless—although some are better than others. They serve their purpose in the defense of the country by their very existence.

It is the duty of all commanders to supervise the care of this equipment and to see that it is constantly ready for service. General Gulick has recently inspected all the harbor defenses along the east coast of the United States as far south as Chesapeake Bay. The Harbor Defenses of Portland (Maine) were selected for a test to determine the facility with which the armament could be placed in condition to turn over to the National Guard in case of an emergency.

Instrument Flying

INSTRUMENT flying, the art of guiding an airplane through the air with the aid of the instruments alone and without the pilot orienting himself on the horizon ahead, has been added to the curriculum of the Advanced Flying School of the Army Air Corps at Kelly Field, San Antonio, Texas.

A number of P-T (primary training type) planes, each with the rear cockpit equipped with an airspeed meter, altimeter, turn-and-bank indicator, tachometer and compass, and hooded over with an adjustable canvas hood are used for the first phases of this instruction. Eight hours are given over to practice in this type of flying, the student seated in the hooded cockpit and the instructor in the open one. Starting with straight flying the student learns to fly at a constant altitude and speed, and with the wings level along a compass course, gradually developing skill in this and then advancing to making banks and turns until he can

make these with creditable facility. The instructor travels along to watch out for aerial traffic and to check on the student's work. From the hooded primary type of plane the student advances to one of the larger basic training type planes with the front (pilot's) cockpit also hooded over and with the complete standard instruments.

Supplementing the course in this type of flying are a number of lectures on the subject of instrument flying, or fog-flying, to give it the name by which it is known to the flying fraternity, both in the service and in civil life. Most important is the instruction given in the limitations of instrument flyng, when it should be done and when it should be avoided. Only skilled pilots are able to fly in this manner, and even these have to be broken of the tendency to relay on their "flying instinct" and their "senses" altogether and not on their instruments when they first set out under a completely covered cockpit that blots out all view of the sky.

"Flying instinct," said one instructor, "is a much abused term employed by writers of fiction with which to imbue their heroes; to a great extent instinct plays a part in the piloting of airplanes, but it must be used in conjunction with a good set of flying instruments when you find yourself in a fog or under a hooded cockpit, which simulates the conditions of flying through a fog or clouds. Certain movements in the control of an airplane which are reactions to one's senses, are instinctive, but these same senses cannot be relied upon under all conditions. A person in a whirling chair with his eyes closed, will imagine himself whirling to the left after the chair has ceased whirling to the right and is no longer in motion. In a fog or clouds or heavy storm a plane might be in a tailspin, and the pilot may take it out of the spin, but for a number of seconds thereafter he will feel that he is then spinning in the opposite direction. The flying instruments will indicate what is actually occurring, however."

Student flyers at the Air Corps Primary Flying Schools are apt to be puzzled over the apparent conflict presented by instrument flying as opposed to the problems of normal flying. In common with flying students the world over, many of the beginners have to be broken of their tendency to rely on their flying instruments instead of on their senses when the ground and the sky are visible. Many a novice pilot has come to grief in gliding down to the ground and waiting until his altimeter reads "zero" before attempting to level off and land. Many another has relied on the reading of his airspeed meter to tell him when he is approaching the dangerous stalling speed. For this reason airspeed meters and also turn-and-bank indicators have been taken off the primary types of planes used for primary instruction. It is only after they have had considerable experience in handling airplanes that the Flying School students are given this instrument-flying work.

Aside from the lectures touching on the mechanics of instrument flying, the greatest stress in subsequent lectures on this subject is laid on "when one should" and more particularly "when one should *not*" rely on compass, turn-and-bank indicator and the rest of the fog-flying aids. In other words, the students are taught to differentiate between the conditions under which they should push on and those under which they should turn back or land.

The Designation of Army Aircraft

ARMY Air Corps airplanes are divided into eight classes, according to type or model. Although these planes are invariably known to the layman by their commercial names, the Air Corps knows them by their model designation. These are as follows:

	Model Designation
Pursuit (fighting) planes	P
Observation planes	O
Attack (ground strafing) planes	A
Transport, Cargo, Ambulance, Workshop planes	C
Bombardment planes	B
Primary Training planes	PT
Basic Training Planes, used in transition from primary type to service type planes	BT
Photographic planes	F

Airplanes of experimental and service test status are prefixed by the letters X and Y. Thus a type that is being developed either at a factory or at the Air Corps engineering station at Wright Field, Dayton, Ohio, would be labelled, were it a pursuit plane, "XP," followed by a number which would classify it according to its style, such as "XP6' which was the experimental stage of a pursuit plane made by the Curtiss Company somewhat on the style of the Curtiss Hawk. If this experimental model proves to be of an acceptable type a small lot is then bought and put out at some active station for service test, that is, used in the service with other pursuit machines to test their serviceability and desirability. They would then be labelled "YP6."

There are still some airplanes in the service known by an earlier system of model designation, such as the DH—Dehaviland and the PW—pursuit-watercooled, but these are either obsolete or obsolescent.

All-Purpose Gun Mount Tests

THE all-purpose 75-mm. gun on T3 mount, designed by Maj. G. M. Barnes, has fired to date about 160 rounds at all angles of elevation and traverse. The mount has functioned satisfactorily and no changes except a few minor ones will be made in the carrier prior to shipment to Aberdeen Proving Ground for further test.

The prime mover is being so arranged that the gun can be fired directly from the truck without any modification. Thus the universal gun carriage can either be trailed behind the prime mover or can be lifted off the ground and carried on the prime mover, and can either be taken off the prime mover and fired on the ground or can be fired directly from the prime mover, converting it into a sort of self-propelled mount. The new prime mover has already arrived at Watertown Arsenal and the parts to permit the mounting of the T3 gun upon it are now being made.

Double Trigger for 37-mm. Gun

A DOUBLE trigger arrangement has been authorized to be placed on the 37-mm. gun, M2E1, now under test as a result of former tests conducted at Fort Benning, Ga. During the tests it was decided that this installation will increase accuracy in firing on a target which is moving from right to left. The records show that very few hits were scored in this maneuver, and it is believed that the results of this firing were low because of the unwieldy way in which the gunner has to traverse the gun and pull the trigger. Hits scored while the target was moving in the opposite direction, from left to right, were very satisfactory.

Association Affairs

Committee of Tellers of Election

AT the request of the President of the Association the following members served on the Committee of Tellers which canvassed the ballots for the biennial election of officers and directors of the Association, polls for which closed on September 2, 1930: Mr. A. Y. Leech, Jr., Chairman, Capt. J. K. Christmas and Mr. C. E. McRae. The committee report will be presented by the chairman at the business and technical session of the Association to be held in Washington on the evening of October 8th preceding the annual program of demonstrations and tests at the Aberdeen Proving Ground on the following day.

Dr. L. F. Fuller, Dean of Electrical Engineering at California

DR. L. F. FULLER of Palo Alto, Calif., an active member of the California Post, Army Ordnance Association, was recently appointed head of the Electrical Engineering Department at the University of California. Dr. Fuller is a Major, Specialists Reserve, and has been of material assistance to the San Francisco Ordnance District. At the annual meeting of the California Post, A. O. A., at the Benicia Arsenal last year Dr. Fuller was one of the principal speakers. He is vice-president of the Federal Telegraph Company and in that position of late years has been directing the development of technical and economic features of improved plans for conducting short-wave radio communication between stations separated by great distance.

According to an announcement from the University of California regarding Dr. Fuller's selection, his appointment is one of several recently made by the University to carry out the plan of reorganizing the administration of the Engineering Colleges as approved by the regents of the University.

Dr. Fuller was graduated as a mechanical engineer from Cornell University and holds the degree of Ph. D. from Stanford. He has had very extensive engineering service with leading corporations engaged in the manufacture of electric apparatus and with larger telegraph and radio corporations.

Reserve Officers at Summer Camps

THE following reserve officers of the Ordnance and Specialist Reserves attended the several summer courses of active duty training:

Aberdeen Proving Ground, July 27th to August 9th: Lt. Cols. Andrew F. Carlin, Allston, Mass.; Samuel G. Green, Cherrydale, Va.; James Guthrie, Elyria, Ohio; William T. Hensley, Indianapolis, Ind.; Gordon F. Hull, Hanover, N. H.; Majs. James H. Boerckel, Philahelphia, Pa.; Harold M. Brayton, Dover, N. J.; Frederic C. Clark, So. Manchester, Conn.; Carlos de Zafra, Scarsdale, N. Y.; Robert W. Gardner, Tarrytown, N. Y.; Sheldon D. Graff, Waban, Mass.; Charles O. Gunther, Nyack, N. Y.; Herbert H. Hall, Palisades Park, N. J.; Kenneth L. Holmes, St. Paul, Minn.; James C. Karnes, Washington, D. C.; Henry N. Marsh, Wilmington, Del.; Ellis R. Northrop, Middletown, N. Y.; Alden B. Owen, Ridgway, Pa.; Matthew D. Phillips, Jr., Cleveland Heights, Ohio; Henry G. Roberts, Madison, N. J.; Kenneth I. Tredwell, New Rochelle, N. Y.; Edmund S. Van Brunt, Watertown, Mass.; Charles B. Watkins, Washington, D. C.; Harold J. Williams, Hartford, Conn.

Capts. Louis B. Armbrecht, Wheeling, W. Va.; Robert J. Carper, Wilkes-Barre, Pa.; Herbert V. Coulston, Philadelphia, Pa.; Louis L. Driggs, Jr., New Rochelle, N. Y.; Fred. E. Fish, Ellston, Md.; Arthur M. Gallagher, Philadelphia, Pa.; Joseph B. Hoon, Cleveland, Ohio; Elton W. Jenkins, Dover, N. J.; Robert J. Johnson, Crafton, Pa.; Samuel L. Kerr, Philadelphia, Pa.; Herbert H. Mitchell, Silver Spring, Md.; Ernest C. Moriarty, Washington, D. C.; Bertram V. Nutt, Moline, Ill.; Abner C. Oliphant, Washington, D. C.; Joseph Proske, Chevy Chase, Md.; Paul L. Mardis, Edgewood, Pa.; Earl M. Richards, Beaver, Pa.; Francis J. Rourke, West Roxbury, Mass.; Francis R. Scherer, Rochester, N. Y.; Otto R. Schurig, Schenectady, N. Y.; Frank Short, Newark, N. J.; Weldon D. Smith, Buffalo, N. Y.; Luther M. Walton, Reading, Pa.

1st Lieuts. Cyril E. Baston, Pittsburgh, Pa.; Ralph E. Bevington, Martins Ferry, Ohio; Thomas J. Day, Anniston, Ala.; Ralph L. Dunckel, Bridgeport, Conn.; William M. Dunlap, Oakmont, Pa.; Karl J. Fairbanks, Kenmore, N. Y.; David L. Fiske, New Rochelle, N. Y.; Carlos H. French, Seymour, Conn.; George D. Green, Jacksonville, Fla.; Thomas L. Hapgood, Glenshaw, Pa.; Rowland O. Huddleston, Linwood, Mass.; Stanley R. Kuhns, Parnassus, Pa.; Charles C. Lundy, Davenport, Iowa; G. Malcolm McNeil, Winthrop, Mass.; Alonzo L. Milton, Wheeling, W. Va.; Bernard H. Moran, Natick, Mass.; Joseph A. Nock, Jr., Tarentum, Pa.; James L. Phillips, Birmingham, Ala.; Vernon Reid, Washington, D. C.; Richard W. Saunders, Philadelphia, Pa.; Harold M. Webster, Hartford, Conn.; Ralph M. Wood, Birmingham, Ala.

2nd Lieuts.: William C. Aber, Oakmont, Pa.; Rufus L. Adair, Jr., Atlanta, Ga.; Charles P. Almon, Jr., Birmingham, Ala.; Arthur G. Baral, New Britain, Conn.; Harvey R. Battrell, LaCarne, Ohio; Christopher E. Blaydon, Newport News, Va.; Allmond O. Bozarth, Philadelphia, Pa.; Arthur D. Brittingham, Bridgeport, Conn.; Nelson E. Cook, Wheeling, W. Va.; Lester P. Cramb, Uxbridge, Mass.; Benjamin L. Crew, Canton, Ohio; Joseph W. Gaffney, Taunton, Mass.; Edward F. Gilroy, Jamaica, N. Y.; Robert W. Graham, New Kensington, Pa.; Henry C. Griggs, Waterbury, Conn.; James L. Heilman, Washington, D. C.;

Clarence P. Hendricks, Bethlehem, Pa.; Lane W. Hildreth, Philadelphia, Pa.; Fred B. Holgate, Newark, N. J.; Leroy G. Huggins, Birmingham, Ala.; Harold P. Jordan, Sharon Hills, Pa.; Norman J. Kramer, Schenectady, N. Y.; Nicholas H. Krayer, Lebanon, Pa.; Milton L. Lazear, Bridgeport, Ohio; Mitchell P. Ledbetter, Birmingham, Ala.; Elisha J. McKeon, Plainfield, N. J.; Gordon I. McNeil, Winthrop, Mass.; Lloyd R. Macadam, Taunton, Mass.; William E. Mackintosh, New York, N. Y.; Carl J. Marshall, East Milton, Mass.; Hector A. Moineau, Marlboro, Mass.; Jerome H. Oleksiw, Shamokin, Pa.; William J. Peterson, Melrose, Highlands, Mass.; George E. Pierson, Trenton, N. J.; Edward J. Poitras, Salem, Mass.; John W. Robinson, Brooklyn, N. Y.; Donald L. Ross, Springfield, Mass.; Philip A. Salmon, Elizabeth, N. J.; Thomas V. S. Skinner, New York, N. Y.; Alexander F. Stoeger, Jr., New York, N. Y.; Wilmer C. Swartley, Jr., Philadelphia, Pa.; Peter R. tum Suden, Jr., Woodhaven, N. Y.; Timothy J. Wisecarver, Jr., Pittsburgh, Pa.; Edward S. Wotkyns, Waterbury, Conn.; Wilmer R. Wright, Baltimore, Md.; Bradford P. Young, Pittsburgh, Pa.

Rock Island Arsenal, July 6th to 19th: Branch Assignment Group: Lt. Col. Jay A. Utts, Savanna Proving Ground, Ill.; Majs. Clarence M. Eason, Detroit, Mich.; Allen C. Harris, Dayton, Ohio; Sharpe Ireland, Washington, D. C.; Hugh B. LaRue, Kansas City, Mo.; Frank W. L. Peebles, St. Louis, Mo.; Herbert R. White, Detroit, Mich.; John T. Wurster, Cedar Rapids, Iowa; Capts. Paul C. Cunnick, Davenport, Iowa; Oral A. Lansche, St. Louis, Mo.; Oliver M. Leath, Williamsport, Ind.; Oscar von der Luft, Pittsburgh, Pa.; Joseph M. Michaelson, Minneapolis, Minn.; Harrison O. Parker, Georgetown, Ill.; Walter J. Risley, Sr., Golden, Colo.

1st Lieuts.: Fred Hanss, Newcastle, Ind.; Loren M. Jenks, Chicago, Ill.; Herbert S. Karch, Cuyahoga Falls, Ohio; George Oetinger, Jr., Highland Park, Mich.; Sherwood Vermilye, Louisville, Ky.; Harry V. Walthers, Lincoln, Nebr.; Bernard A. Weideman, Madison, Wis.; Harry A. Wilson, Chicago, Ill.

2nd Lieuts.: Harold G. Evans, Savanna, Ill.; Henry Fink, Moline, Ill.; Lyman C. Gerow, Indianapolis, Ind.; Fred L. Green, Detroit, Mich.; Arthur C. Hanson, Rock Island, Ill.; Roy W. Jacobs, Pittsburgh, Pa.; George A. McBride, Alton, Ill.

Territorial Assignment Group: Lt. Cols. Charles S. Cole, Detroit, Mich.; Harry G. Martin, Omaha, Nebr.; Louis Waefelaer, Glenco, Ill.; Capts. Virgil N. Charles, St. Joseph, Mo.; John P. Diehl, Madison, Wis.; Silas C. Hansen, White Cloud, Mich.; Herman L. Harms, Benton Harbor, Mich.; Charles J. McCabe, Detroit, Mich.; Lloyd T. Smith, Ionia, Mich.; Vincent L. Sullivan, Chicago, Ill.

1st Lieuts.: Carl W. Laumann, So. Milwaukee, Wis.; Lester C. Dibble, Mason City, Iowa; Mervin O. Flom, Chicago, Ill.; Leon H. Jagrowski, Detroit, Mich.; Paul V. Palfasch, Chicago, Ill.; Herbert P. Schowalter, West Bend, Wis.; Mathew J. Swatek, Jr., Chicago, Ill.

2nd Lieuts.: Carl R. Birkholz, Lombard, Ill.; Norman E. Dietz, Muskegon, Mich.; Herbert J. Ehrsam, Enterprise, Kans.; Ben M. Gregory, Grand Rapids, Mich.; Fridolph W. Hallgren, Berwyn, Ill.; Alfred D. Hertz, So. Milwaukee, Wis.; Walter A. Hunt, River Forest, Ill.; Richard G. Koch, Milwaukee, Wis.; Reuel D. Layman, Detroit, Mich.; George M. Little, Rockford, Ill.; Callahan J. McCarthy, So. Milwaukee, Wis.; Ernest T. Wahlbom, Rockford, Ill.

Ft. H. G. Wright, July 6th to 19th: Capt. Roy S. Haggard, Mystic, Conn.

Jeffersonville Q. M. Depot, July 6th to 19th: Capt. Camille A. Meyer, Davenport, Iowa.

Miller Field, N. Y., July 6th to 19th: Capt. Emanuel J. Livingston, New York, N. Y.

Watervliet Arsenal, August 3rd to 16th: Capt. James L. Delany, Washington, D. C.

Fort George G. Meade, July 6th to 19th: Col. Frederick H. Wagner, Baltimore, Md.; Maj. Nathan C. Avery, New Britain, Conn.; July 13th to 26th: Capt. Seth Wiard, Philadelphia, Pa.

Tobyhanna, Pa., July 20th to August 2nd: Maj. Paschal W. Barr, Ardmore, Pa.

Camp Perry, Ohio, August 8th to 16th: Maj. Louis E. Brittson, Highland Park, N. J.

San Antonio Arsenal, July 6th to 19th: 1st Lieut. Jules B. Aveilhe, Brownsville, Tex.

Picatinny Arsenal, July 6th to 19th: Col. Hardee Chambliss, Washington, D. C.; Capts. George R. Ensminger, New Brunswick, N. J.; Norman Hicks, Watertown, N. Y.; Arthur F. Hubbard, Tippecanoe City, Ohio; Joseph A. Llompart, Washington, D. C.; Charles A. Tibbals, Jr., Chicago, Ill.

1st Lieuts.: Raymond G. Curtin, Brooklyn, N. Y.; Herbert K. Cummings, Washington, D. C.; Spencer C. Noble, Philadelphia, Pa.; 2nd Lieuts.: Albert S. Branson, Philadelphia, Pa.; Harold S. Christopher, St. Louis, Mo.; John Millar, 3rd, Newport News, Va.; Donald Morris, Detroit, Mich.; Carl A. Poppino, New York, N. Y.; August 3rd to 16th: Maj. Reuben S. Tour, Cincinnati, Ohio.

Office of the Chief of Ordnance, Washington, D. C.: July 27th to August 9th, 1st Lieut. Christopher H. Wollenberg, Farmington, Conn.; August 3rd to 16th, Capt. David L. Woodberry, Aberdeen, Md.; 1st Lieut. Hillier McC. Burrowes, Grove City, Pa.; August 17th to 30th, Capt. Harold E. Schofield, Wissahickon, Pa.; Maj. Robert G. Cook, Philadelphia, Pa.

Delaware Ordnance Depot: August 17th to 30th, 2nd Lieut. Henry S. Moulthrop, Pittsburgh, Pa.

Erie Ordnance Depot: August 10th to 23rd, Capt. Don P. Carpenter, Brazil, Ind.

New York District Ordnance Office: July 1st to 14th, Capt. Francis P. O'Hara, Rye, N. Y.; July 14th to 27th, Capt. Theodore A. Distler, New York, N. Y.; July 17th to 30th, Capt. Herman P. Gould, Brooklyn, N. Y.

Pittsburgh District Ordnance Office: July 6th to 19th, Capt. John O. Keller, State College, Pa.

Baltimore District Ordnance Office: July 7th to 20th, 1st Lieut. Paul K. Klaesius, Baltimore, Md.; August 11th to 24th, 1st Lieut. Fernand F. Klenk, Baltimore, Md.

Springfield Armory, July 6th to 19th, Maj. Clarence E. Coolidge, Atlanta, Ga.; September 4th to 27th, Maj. Herman L. Wittstein, New Haven, Conn.

Watertown Arsenal, July 6th to 19th: Majs. Harry Hoisington, Davenport, Iowa; George J. Schladt, Dover, N. J.; Granville E. Webster, Dover, N. J.; Capts. Donald C. Fabel, Cleveland, Ohio; Edward M. Floreyk, Wharton,

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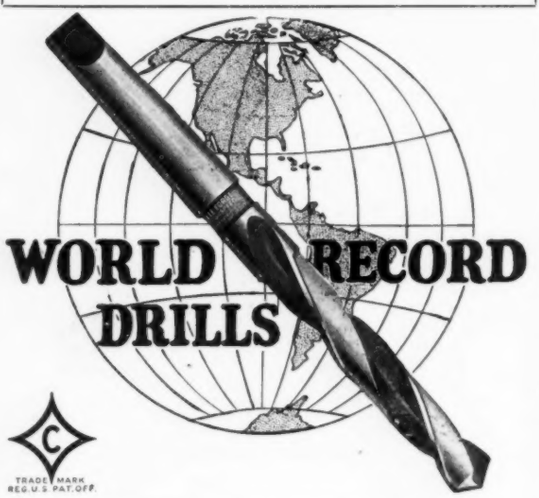

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Frankford Arsenal, July 6th to 19th: Majs. James Barnes, Bryn Mawr, Pa.; John H. Barrett, Hyattsville, Md.; Walter W. Golden, Youngstown, Ohio; Amos T. Pagter, Washington, D. C.; Capts. John F. Ballenger, Detroit, Mich.; Byron W. Benedict, Lansdowne, Pa.; Hiram B. Channon, Natick, Mass.; Vladimir V. de Sveshnikoff, Washington, D. C.; Abraham M. Ehrlich, Washington, D. C.; LeRoy C. Ensminger, New Britain, Conn.; Charles W. Francis, Cleveland, Ohio; Edwin H. Sager, St. Louis, Mo.

1st Lieuts. Arthur P. Bliss, Waterbury, Conn.; Charles R. Burlingame, Moores, Pa.; Terrell A. Busby, Charleston, S. C.; James T. Johnson, Jr., Birmingham, Ala.; Charles E. Kelley, Waterbury, Conn.; Robert J. King, New Britain, Conn.; Charles H. McCann, North Adams, Mass.; Carl D. Miller, Millis, Mass.; Arthur H. Nordstrom, Washington, D. C.; Carlyle H. Strand, Washington, D. C.; James S. Woodward, Schenectady, N. Y.; 2nd Lieut. Robert A. Williams, Webster Groves, Mo.

Birmingham District Ordnance Office: July 13th to 26th, Maj. Ernest L. Lucas, A. & M. College, Miss.; Capts. Samuel M. Regar, Tampa, Fla.; Henry C. Winters, Montgomery, Ala.; 1st Lieuts. Patrick C. O'Shee, Mobile, Ala.; Robert E. Smith, Birmingham, Ala.; 2nd Lieuts. Paul L. Bartow, St. Petersburg, Fla.; Wilbur B. King, Anniston, Ala.; James W. Shealy, Birmingham, Ala.; James C. Walker, Atlanta, Ga.

Chicago District Ordnance Office: July 20th to August 2nd, Capt. Raymond E. Kirk, Bozeman, Mont.; July 28th to August 10th, Capt. Barrett Rogers, Oak Park, Ill.; Capt. Fred R. Zimmerman, Chicago, Ill.

Cleveland District Ordnance Office: September 4th to 17th, 2nd Lieut. Walter B. McClelland, Euclid, Ohio.

Camp Knox, Kentucky: Capt. Alfred J. Fenner, Elyria, Ohio.

Fort Lewis, Washington, July 6th to 19th: Maj. Welton J. Crook, Stanford University, Calif.

Fort Sill, Okla., July 6th to 19th: Capt. E. Richard Page, Norman, Okla.

Camp Trumbull, Conn., July 6th to 19th: Maj. Melville L. Merrill, West Hartford, Conn.

Massachusetts Institute of Technology, August 17th to 30th: Col. James F. Monaghan, West Newton, Mass.; Lt. Cols. Robert S. Williams, Cambridge, Mass.; Clarence E. Davies, New York, N. Y.; Majs. Earle Buckingham, Belmont, Mass.; Addison F. Holmes, Winchester, Mass.; Warren B. Hood, Philadelphia, Pa.; Edward P. King, Watervliet, N. Y.; Harry I. Lewis, Narberth, Pa.; Clark S. Robinson, Reading, Mass.

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1st Lieuts. Donald D. Alexander, Irvington, N. J.; William H. Bender, Philadelphia, Pa.; William M. Croft, Jamaica Plain, Mass.; John F. Drennan, Springfield, Mass.; John J. Egan, Brooklyn, N. Y.; Winfield S. Gibbs, Jr., Philadelphia, Pa.; Edward Gluck, New York, N. Y.; Kelsey H. Jewett, Buffalo, N. Y.; Franklyn C. Lindley, Pittsfield, Mass.; James D. Milne, Pittsfield, Mass.; Alban J. Parker, White River Junction, Vt.; Nicholas R. Wilson, Snyder, N. Y.

2nd Lieuts. William P. Blake, New York, N. Y.; Charles E. Geisler, Somerville, Mass.; Clem W. Lepsch, Hornell, N. Y.; Charles F. Schmid, Ansonia, Conn.; William L. Warner, Alplaus, N. Y.

Association Membership

THE Association has its government vested in a Board of Directors, six of whom are elected by general ballot of the entire membership, for terms of four years, and one director representing each local post, the latter being elected by the respective posts. The officers, with one director elected by the Board of Directors, constitute the Board of Trustees which has the active management of the affairs of the Association. The President and Vice-Presidents are elected every two years by general ballot and the Counsel, Treasurer and Executive Secretary are appointed by the Board of Directors. The Association was incorporated in 1928 under the laws of the District of Columbia.

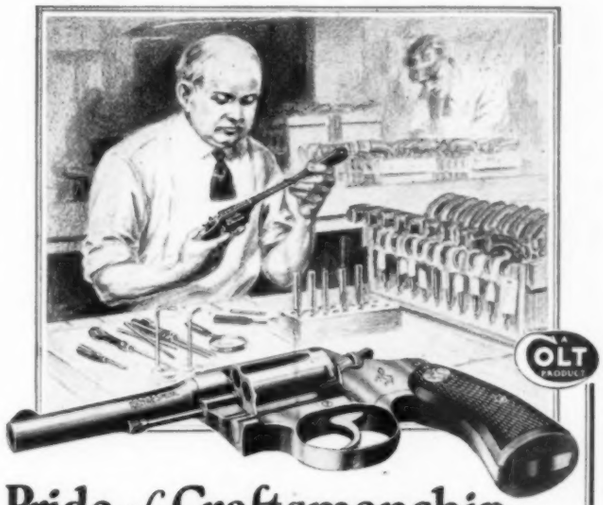
Over 90 per cent of the membership of the Association consists of executives and engineers of American industry who are cognizant of the importance of industrial preparedness. These gentlemen who, through affiliation with the Association are kept informed of current development of munitions, constitute a large portion of the civilian nucleus upon whom our Government will depend for the manufacture of ordnance in time of emergency.

The following extracts from the Constitution and By-Laws of the Association define the several classes of membership.

"SEC. 1. Full membership in the Association shall be open to all men who are American citizens and who are interested in promoting the cause of industrial preparedness, particularly in connection with the design, procurement, production, manufacture, inspection, test or supply of ordnance material.

"SEC. 2. Life membership in the Association shall be open to all men who are American citizens and who are interested in promoting the cause of industrial preparedness, particularly in connection with the design, procurement, production, manufacture, inspection, test or supply of ordnance material.

"Life membership shall continue during the lifetime of the life member and shall expire at death. It shall not be transferable.



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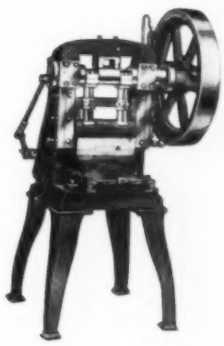

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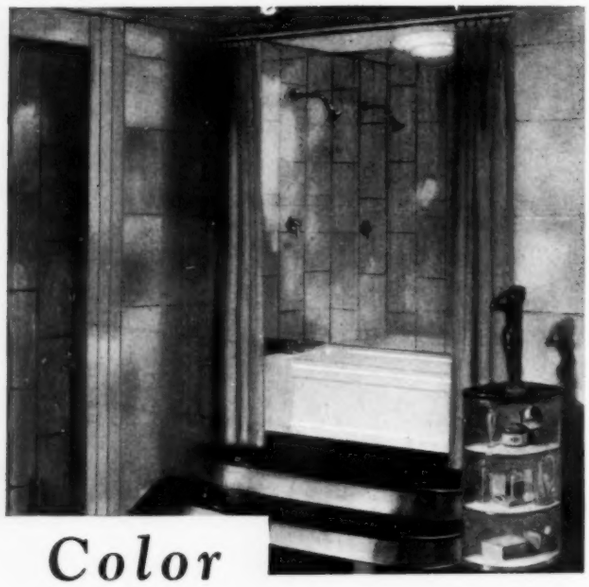

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"SEC. 3. Student membership in the Association shall be open to all men who are American citizens and who are students in technical schools or colleges. Student members shall not vote or hold office in the Association.

"SEC. 4. Group membership in the Association shall be open to all individuals, firms, companies and groups controlled by American citizens who are interested in promoting the cause of industrial preparedness, particularly in connection with the design, procurement, production, manufacture, inspection, test or supply of ordnance material.

"Group members shall have the privilege of nominating ten men for full membership in the Association, and members thus nominated shall pay no dues.

"SEC. 5. Honorary membership for life shall be conferred, in the discretion of the Board of Trustees, upon persons who have rendered meritorious service to the cause of industrial preparedness. Honorary members shall be entitled to all privileges of full membership except as otherwise provided in this Constitution and in the By-laws."

By-Laws

"5. The fee for life membership in the Association shall be One Hundred ($100.00) Dollars. The annual dues for membership in the Association shall be, for members, Five ($5.00) Dollars; for student members, Two Dollars and Twenty-five Cents ($2.25); and for group members, One Hundred ($100.00) Dollars, payable in advance. These sums are in addition to whatever dues or assessments may be imposed by the respective local posts in the case of members."

Deceased Members

Since publication of the last issue of ARMY ORDNANCE, National Headquarters has learned with regret of the death of Waldo C. Bryant, Bridgeport, Conn.; William W. Essick, Jr., Earlville, Pa.; and John A. Murphy, St. Louis, Mo.

New Members

The following have been admitted to membership in the Association since the last issue of ARMY ORDNANCE: Henry W. Armstrong, Bristol, Conn.; Anson Averell, Berkeley, Calif.; James J. Campbell, Dearborn, Mich.; A. L. Churchill, Berkeley, Calif.; O. S. DeLancey, Ashburn, Mo.; Lester C. Dibble, Mason City, Iowa; A. H. Ferrandou, Detroit, Mich.; Mark F. Finley, Jr., Washington, D. C.; J. W. Frazer, Detroit, Mich.; Carlos H. French, Seymour, Conn.; W. S. Graves, Detroit, Mich.; E. E. Handy, Wilmington, Del.; W. C. Harris, Erie, Pa.; T. W. Hetherton, Wilmington, Del.; E. C. Humphery, Pennsgrove, N. J.; W. B. Hurley, Detroit, Mich.; Roy E. Joegensen, Hayward, Calif.; William Kirk, Pennsgrove, N. J.; F. E. Jacquot, Louviers, Colo.; M. C. Knake, Barksdale, Wis.; John R. Lee, Detroit, Mich.; J. H. Mack, Detroit, Mich.; Alan C. Mattison, Rockford, Ill.; Stuart McLain, Ann Arbor, Mich.; J. E. Rohrer, Meridian, Miss.; Joseph C. Miller, Jr., Marine City, Mich.; James W. Mills, Granite City, Ill.; Geo. A. Moshchansky, So. Milwaukee, Wis.; L. S. Munson, Wilmington, Del.; John T. Naylon, El Reno, Okla.; L. G. Peed, Detroit, Mich.; F. L. Rockelman, Detroit, Mich.; A. vanderZee, Detroit, Mich.; and S. K. Varnes, Wilmington, Del.

All members are urged to notify promptly the office of the Executive Secretary of change of address.

Digest of Ordnance Patents

THE following digest of recent ordnance patents is by W. N. Roach, Chief, Patent Branch, Office of the Chief of Ordnance. Letters patent have been issued:

To August Dabrasky, Office of the Chief of Ordnance, U. S. Army, No. 1,742,436 for a trunnion bearing for ordnance. This invention contemplates the provision of self-aligning antifriction bearings for the trunnions.

To Christian von Hofe, Karl Petschenig, and Johann Schier, assignors to the Czechoslovak firm C-P. Goerz Optische Anstalt Aktiengesellschaft, etc., No. 1,744,994, for a sighting telescope for ordnance, machine guns, and the like. The invention contemplates the provision of a telescope easily accessible to the eye of the user irrespective of the position or elevation of the gun.

To Maj. Gladeon M. Barnes, Ord. Dept., U. S. A., Watertown Arsenal, Watertown, Mass., No. 1,745,468 for a loose liner for guns made of drawn seamless tubing and having its inner layers permanently set by overstraining.

Also to Major Barnes and George M. McCann, Office of the Chief of Ordnance, No. 1,748,272 for a liner for guns having a smooth unbroken exterior surface forward of the ammunition chamber and having clearance from the gun tube at all points.

Also to Mr. McCann, No. 1,750,722 for a firing mechanism which contemplates an improvement in the Tasker Firing Mechanism, designed to prevent injury to the firing pin due to failure to release the lanyard.

To Albert J. Ashdown, No. 1,746,179 for a stroboscopic apparatus. The device covered by this patent consists of two shutters preferably in the form of nested cylinders, the inner cylinder rotating at a slower speed than the outer cylinder and controlling the periods of register of the observing apertures.

To Lieut. Joseph T. Zak, 3rd Infantry, U. S. A., No. 1,747,207 for a range-finding instrument. This is a range finder capable of being easily and quickly set and used, and is characterized principally by having a range scale inscribed on an elastic band.

To Howard A. Droitcour, No. 1,747,664 for an apparatus for automatically training guns, etc., on moving objects. This invention contemplates electrically controlling the movement of a gun through means of selenium cells which are affected by the image of the object upon which the gun is trained.

To Nicholas E. Methlin, assignor to Schneider & Cie, No. 1,750,724 for a combined automatic breech closing and opening and loading mechanism for automatic guns.

To Henry W. Nieman, No. 1,751,652, for a synchronous amplifying control mechanism designed to control the training of guns though capable of other uses.

Also to Mr. Nieman, assignor to the Bethlehem Steel Company, No. 1,751,649 for a fire-control mechanism. This patent covers an elaborate system for automatically determining firing data in relation to a moving target.

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CLEVELAND
OHIO

To Victor Hammar, No. 1,754,943 for a field gun with tube recoil which contemplates supporting the tube within the cradle by series of rollers.

To Thomas J. Stephens, Coast Artillery Corps, No. 1,754,653 for a predicting device which has but a single scale and may be set during the interval between plotting observations.

To Hermann Schuler and Anton Gietmann, assignors to Rheinische Metallwaaren-und Maschinenfabrik, No. 1,739,-921 for operating electric projectile fuzes. This invention consists of an electrical device attached to the muzzle of a gun with means for conducting an electric current through the device so as to induce a current in the electrical equipment of the fuze as the fuze passes through the device during the passage of the shell from the muzzle of the gun.

To Walter J. Larson, No. 1,743,817 for a gun wad. This patent covers a gun wad having a number of depressions in one face thereof, so as to hold the layer of shot adjacent the wad in spaced relation causing the subsequent layers to also be spaced to the end that the shot may not be deformed in passing through a choke bore barrel.

To Pieter Daniel Van Essen, No. 1,742,836 for a projectile intended primarily for use in trench mortars and consisting of an ogival head to which is attached a rearwardly tapering body, the idea being to present a larger area for the powder pressure to act upon so that the walls of the shell may be made thinner and capable of carrying a greater charge.

To Hans Rathsburg, assignor to Rheinisch-Westfalische Sprengstoff-Aktiengesellschaft reissue No. 17,540 for a primer composition comprising guanylnitrosaminoguanyltetracene mixed with a salt of an organic nitro-compound specifically trinitroresorcinate of lead.

To Reginald J. Alden, No. 1,741,900 for a projectile made of glycerine and steric acid which will be projected from a gun in a comparatively soft solid mass so as to incapacitate temporarily without seriously injuring the person.

Also to Mr. Alden, No. 1,741,901 for a cartridge provided with a projectile consisting of a compact mass of liquid wholly confined in the cartridge and ejected in an unconfined state.

To Arthur Adelman, Office of the Chief of Ordnance, No. 1,744,194 for a fuze for projectiles. This patent covers an improvement of an old style elongated nose fuze consisting in a set-back sleeve surrounding the fuze and normally confining a safety pin in place.

To Pietro Locori, No. 1,744,233 for projectiles for anti-aircraft fire. The patent covers a shell in which is housed a cable attached to a parachute being expelled from the bottom of the shell by an explosive charge so that the cable may be suspended from the parachute.

To Gregorio Seaglia, assignor Societa Italiana Ernesto Breda, No. 1,744,713 for a bomb or grenade in which a cap is normally held by a safety pin, which pin is extracted before the grenade is thrown, and the cap is hinged to a safety slide which is withdrawn by air pressure on the cap during flight of the grenade. The grenade is of the always type, the explosive charge forming one of the movable elements and the striker the other element.

To Hans Gruber, No. 1,745,758 for a fuze. The main object of this invention appears to be a provision of a fuze

which may be ignited by the passage of a vehicle or light weight thereover and which is thoroughly protected against the entrance of moisture.

Also to Mr. Gruber, No. 1,745,759 for a device for converting projectiles, bombs or the like into mines. In the device covered by this patent an adapter containing an explosive charge is screwed into the shell in place of the ordinary shell fuze and the fuze of his former patent No. 1,745,758 is screwed into the adapter.

To Einar Arthur Johnson, No. 1,746,397 for a bullet and bullet guide. The invention contemplates a bullet having a hollow tapered rear portion and a guide of sufficient diameter to fit snugly in a shell provided with a recess to receive the hollow portion of the bullet.

To William S. Heitmann, Frankford Arsenal, Philadelphia, Pa., No. 1,748,288 for a process for making tracer composition. The process consists in adding a mixture of combustible ingredients to a solution of metallic resinate, driving off the solvent and grinding and grading the resultant mass.

To Frederich Olsen, formerly of Picatinny Arsenal, Dover, N. J., No. 1,748,455 for a delay powder. The patent covers a slow burning powder including charcoal, sulphur, an oxodizing agent and a triphenylphosphate.

To Gilbert E. Rogers, Picatinny Arsenal, No. 1,749,088 for a fuze for projectiles. The main object of this invention is to provide a complete assembled plunger unit carrying a bore-safe firing pin suitable for use in a combination point-detonating and percussion fuze.

To Gregorio Scaglia, assignor to Italiana Ernesto Breda, No. 1,749,720 for an impact ignition device. This invention relates to an always-fuze in which one element is connected to the casing by a universal joint and the other element is guided by the casing in swinging about such joint toward the first element.

To Nicholas E. Methlin, assignor to Schneider & Cie, No. 1,750,723 for a combination fuze provided with a safety device.

To Paul Liebergeld, No. 1,752,188 for a mechanical time fuze. This invention contemplates the provision of a securing device in addition to the securing device which is released at the moment of firing, the additional securing device being provided between the pointer and the time-determining ring. The device remains effective after the gun has been fired and prevents coaction of the pointer with the time-determining ring but allows rotation of the pointer for a time sufficient to prevent a premature explosion of the shell.

Also to Mr. Olsen and Clarence J. Bain, of Picatinny Arsenal, No. 1,752,391 for a method of loading explosives. The patent covers the method of pouring moulten explosives into a container and then adding pellets of ammonium nitrate.

To Charles R. Borland, assignor to the American Powder Co., No. 1,752,881 for the manufacture of smokeless powder. This patent concerns the hardening of pellets of grains of smokeless powder by spraying atomized solvent on the powder grains and moving the grains so that the new grains and new surfaces are continually presented to the sprayed solvent.

To Maj. Julian S. Hatcher, Ord. Dept., U. S. A., No.

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1,753,413 for a cartridge case so formed as to secure the advantages of both the rimless and rim cartridge.

To Arthur W. Peters, No. 1,753,472 for a cartridge adapter. This invention contemplates a specific form of cartridge adapter in which the construction is simplified and the association of the cartridge with the adapter is facilitated.

To Samuel G. Wiley, Picatinny Arsenal, No. 1,754,134 for a means for operating aircraft lights. This invention contemplates providing a separable casing normally held together by a strip of flexible material wound about it, which material unwinds during the flight of the casing and eventually allows the same to separate.

To Dr. Tenney L. Davis, No. 1,754,417 for an explosive and solvent therefor. The explosive comprises nitro-guanidine and an aliphatic nitroamine.

To Capt. Louis L. Driggs, Jr., Ord. Res., and Harry B. Faber, No. 1,754,986 for fixed ammunition. This invention contemplates connecting the container of a signalling cartridge or flare as well as the signal to the parachute so that the container may not be free to drop, causing possible injury to person or property.

To Herbert Ruhlemann, assignor to Rheinische Metallwaaren-und Maschinenfabrik, No. 1,755,023 for an electric fuze for projectiles. This invention contemplates the provision of a permanent magnet within a fuze adapted to move through the coil through inertia due to percussion or impact to generate a current in the coil and thereby heat the resistance wire in the primer.

To George B. Oelike, No. 1,739,608 for an electrical remote control for ordnance. This control is intended primarily for machine guns, though probably capable of other uses. There is provided a series of electro magnets which may be successively energized from a distance to elevate the gun and to traverse it.

To Crawford C. Loomis, assignor to Remington Arms Company, Inc., No. 1,740,187 for firearms. This firearm has an elongated magazine housed in the stock from which the cartridges are fed to the cartridge chamber.

To Robert M. Bair, No. 1,740,561 for a coaching and aiming apparatus for firearms. The device provides two rests for firearms sufficiently close together to allow the instructor using one of such firearms to instruct the pupil using the other.

To Hermann Schuler and Friedrich Linder, assignors to Rheinische Metallwaaren-und Maschinenfabrik, No. 1,740,907 for a carriage for light ordnance. This invention covers a tripod for machine guns having a specially constructed upper carriage with hinged connections to permit the gun to be used as a ground gun or in antiaircraft fire.

To Frank F. Burton, assignor to Winchester Repeating Arms Co., No. 1,741,281 for a trigger mechanism for firearms designed to give a smooth action in releasing.

To Christian Pfeiffer, assignor to Colt's Patent Fire Arms Co., No. 1,741,432 for a speed regulator for machine guns. The main objects of this invention appear to be the provision of the speed regulator which forms a permanent part of the firearm, and to utilize the same brake or retarding mechanism which serves to absorb the recoil of the barrel and barrel extension to effect retarding of the breech bolt.

To Edmund C. Fey, No. 1,743,201 for an apparatus for indicating the accuracy of aim. The device provides targets either moving or stationary with means for indicating that the firearm is properly aimed on the target, the firearm using no projectile during such practice.

Also to Mr. Fey, No. 1,743,337 for a rifle range. In this invention there are provided targets and repeating rifles so arranged that when a rifle is properly aimed on a target and the trigger pulled, indication of proper aim is given without the use of ammunition.

To Charles D. Meyer, No. 1,743,472 for a semiautomatic rifle. This invention relates to a gas-operated gun which may be used as a hand-operated rifle. The main object appears to be simplification of construction.

To Benito D. Valeriano, No. 1,743,906 for a rifle sight. The invention contemplates providing attachments which may be readily placed over the front sight and rear sight, which attachments are provided with aluminum strips which may be seen in the dark.

To Maj. James L. Hatcher, Ord. Dept., U. S. A., No. 1,744,162 for a gun. This invention contemplates unlocking the breech bolt through rotating movement of the gun barrel.

To Hermann Schuler, assignor to Rheinische Metallwaaren-und Maschinenfabrik, No. 1,746,364 for an automatic firearm. The patent covers a specific form of tripod which permits the gun mounted thereon to be used in low and high-angle firing.

To Fritz Herlach and Theodore Rakula, assignors to Rheinische Metallwaaren-und Maschinenfabrik, No. 1,746,471 for an automatic firearm. The present invention contemplates the provision of a special form of breech bolt and accelerator.

To Capt. Louis L. Driggs, Jr., Ord. Res., and Henry B. Faber, No. 1,747,057 for a firearm. This invention relates to a specific form of Very pistol for discharging signals.

To Frantisek Janecek, No. 1,747,546 for a machine gun. The invention relates to special feed for machine guns having drum type magazine.

To Robert F. Hudson, assignor to Automatic Guns, Inc., No. 1,749,137 for a machine gun. This invention relates to a specific form of gun, power to operate which is supplied by the gases of explosion, and one which may be adjusted to various speeds of operation.

To Rudolf von Frommer, No. 1,749,726 for a cartridge guide for repeating guns. This patent covers a specific form of cartridge guide.

To Louis S. Marsh, assignor to Boeing Airplane Co., No. 1,750,112 for a gun-feeding mechanism. The main object of this invention is to provide means whereby a cartridge belt of considerable length may be supplied to an aircraft machine gun, and for this purpose a spool upon which the belt is wound is made use of with brake mechanism operated by operation of the gun trigger to release the spool to allow advance of the belt, and then again to contact the spool to prevent over-running thereof.

To William S. Swift, No. 1,750,139 for a revolver holster. The main object of this invention is to provide means for latching the revolver within the holster to prevent accidental displacement thereof.

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WORLD PATENTS

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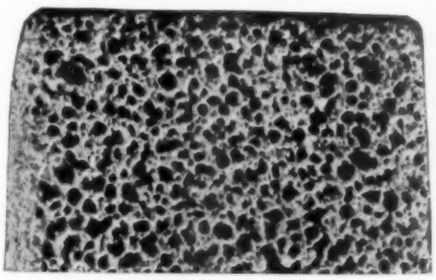

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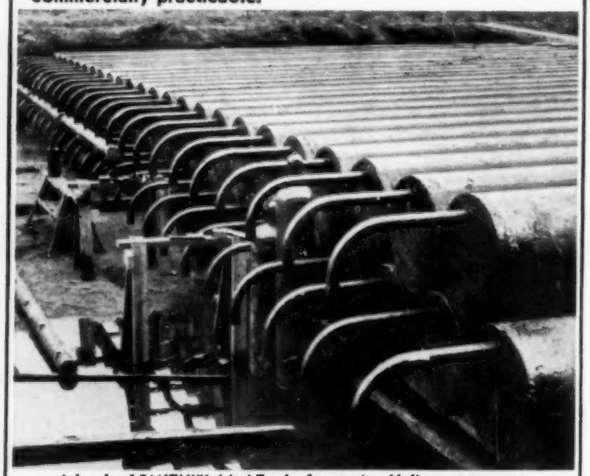

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Foreign Reviews

THE following reviews of recent foreign publications are by J. Marron Dundas, of the Editorial Staff of this Journal:

GREAT BRITAIN

Army, Navy and Air Force Gazette
June 5, 1930

THE INDIAN SCENE

From the author's remarks one gathers that once only has the dove of peace quitted India—her home since British occupation. This was in 1857 when a serious outbreak of native troops occurred. At the present time the Indian Army has the unpleasant task of repressing such disturbances as the Gandhiites may create. The troops, we are told, are highly efficient. Mechanization has made such progress that two divisional trains, two divisional ammunition columns and a field artillery brigade are functioning, and ambulances drawn by the patient bullock have been replaced by six-wheel motor vehicles.

Army, Navy and Air Force Gazette
June 12, 1930

THE CHANNEL TUNNEL

The rejection by the Labor government of the scheme for a tunnel between England and France is mainly based on economic grounds. It would not help the unemployment situation for reasons given. The military authorities also are against the project because of the enormous cost and comparatively small defense value of the undertaking.

Army, Navy and Air Force Gazette
June 26, 1930

THE FUTURE OF THE ARMY IN INDIA

The second volume of the Report of the Indian Statutory Commission is just out. The report comes to the perfectly obvious conclusion that India must possess a highly efficient army to defend her frontiers in the northwest. The present military establishment costs £41,000,000 to maintain and "exists for the defence of India from external aggression and for the maintenance of internal order." Abstracts here given cover the British element in the army, which for a long while cannot be replaced by the Indian element, the Imperial problem involved, Indianization, internal security, and the Indian States and Federal unity. The problems presented are grave and it is to be hoped they will be settled in a manner compatible with the peace of the Empire.

THE ROYAL AIR FORCE DISPLAY

Attendance at this event, which is held at Henden, is expected to reach the 150,000 mark. The King may attend, weather permitting, and members of the Royal family will be present as well as the Prime Minister and a distinguished company from the Diplomatic Corps. A new development of the autogyro and other types of interest may be on view. The training flights to be held are the actual culmination

of the year's training in the Air Force. A new feature will be a colored smoke display. Two machines using smoke, if possible, in the R. A. F. colors will weave patterns in the sky. A set piece will illustrate "air action taken by this country against certain pirates in full conformity with, though not arising out of, its obligations under the Covenant of the League of Nations and the Kellogg Pact." Congratulations to the R. A. F.

FRANCE

Revue d'Artillerie
April, 1930

MODERN SYSTEMS OF ARTILLERY

General Challeat, in his first chapter, defines what an artillery system is and how important it is. His second chapter introduces the reader to such a system in the "sainted days of yore"—before 1914, while his third makes clear the influence of war—of course the late war—upon the organization of modern artillery systems. War doctrine, he holds, contributes to formulate the following desiderata, the chief of which are: Increase of range; facilitating the use of artillery by massive and rapid fire power; and increasing the mobility of matériel by motorization.

General Challeat has considerably clarified a subject which in other hands has accumulated not a little mist.

STUDY OF A CONCRETE CASE OF THE USE OF ARTILLERY IN ATTACK (*Continued*)

Students of grand artillery tactics may find this of interest. A colored map of the terrain is annexed.

ARTILLERY ON THE OFFENSIVE IN STABILIZED WARFARE (*Continued*)

This is a translation from the original German "*Die Artillerie beim Angriff im Stellungskrieg.* The translation is done by H. Brunet, *Chef de Bataillon d'Infanterie,* and N. Aizier, Captain of Artillery. A reference is given to preceding chapters of the article.

THE LOMBARD FIRE TABLES. A CONTRIBUTION TO ARTILLERY HISTORY

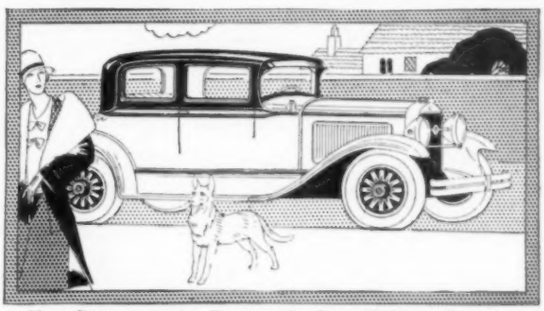
A military bibliophile would enjoy reading "*Les tables de tir des canons et des obusiers, avec une instruction sur la maniere de s'en servir, a l'usage de MM. les officers du corps royal de l'artillerie, calculeés par M. Lombard, professeur royal aux Ecoles du meme corps, á Auxonne,*" 177 pages, published in 1787. A certain Lieutenant Bonaparte must have used it. The "Dictionnaire d'Artillerie" (1822) mentions these fire tables as the only ones in use. They were likewise used during all the campaigns of the Revolution and the Empire.

THE SCHNEIDER TELEINDICATOR (STROBONEON A. F. TYPE)

Revue d'Artillerie
May, 1930

ARTILLERY MANEUVERS

General Faugeron, we confess, has written a rather intriguing paper. Ordinarily, he points out, the word maneuver calls forth the idea of a combination of fire and movement. Yet artillery itself is, in some sort, the very arm of immobility and when moving loses its power of action. Is no contradiction entailed in coupling the words "maneuver" and "artillery"? Some artillerists, unfortunately, seem to think so, seeing in their chosen arm but a support of the infantry. So much is this true, that when



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a maneuver is planned the artillerist is not consulted. Many will disagree with the author in his conclusions, perhaps, but few who know good clear French will skip his paper which, besides an argument, is a working resumé of military history.

Study of a Concrete Case of the Use of Artillery in an Attack (*Continued*)

Artillery in the Offensive in Stabilized Warfare

Fire of a 75 at an Objective Near a Friendly Crest

A problem for an artillery observer who may wish to know the limits of safety when, as he is posted in an advance observatory on a crest and not far from the enemy, the path of fire lies over his head.

La Revue des Forces Aeriennes
June, 1930

The 21st Aviation Regiment

Lovers of this famous organization will be pleased with this beautifully written sketch of its achievements.

Aviation and the Intelligence Service in a Modern War

A brief but pointed reminder by Brevet Colonel Guillemeny that the air arm is among the most important agents of the Intelligence and its communications should be treated accordingly.

Available Air Forces

A glance at what might have been in 1914 had there been an air force more like the present and what might be in the future. A very definite recommendation is made that reconnaissance esquadrilles be equipped with suitable flying matériel.

Aeronautics on the Left Wing of the Allied Armies

Penetration into the Sahara

The French possessions in Africa are Algiers and the Protectorates of Morocco and Tunis, the colonies of Western Africa and Equatorial French Africa, with their illimitable possibilities. In the center of these, however, lies one of the vastest deserts in the world, the Sahara, till lately little—and that badly—known. Lieutenant Colonel Gallet's article makes the reader better acquainted with an abode where Harpocrates, god of silence, would have been forced to vocalize.

New Photographic Material of the Air Forces

Results obtained since 1926 in providing new matériel. Nine illustrations.

An Air Mission in the Tibesti Region

Probable Misses in an Aerial Bombardment

Gen. Felix Maret handles well this problem which is to determine the relative probability of hitting objects in an aerial bombardment.

PORTUGAL

Revista de Artilharia
May, 1930

Garrett, Soldier of the Volunteer Academic Corps, 1832-1834 (*Continued*)

João Baptista da Silva Leitão de Almeida Garrett, to give him his musical full name, gazes at one from the frame of his portrait annexed to this chapter. This article, by Col. Henrique de Campos Ferreira Lima, Director of the

Portuguese Military Historical Archives, should be read by those who believe that literary pursuits unfit a man for military life. He probably was a descendent of English stock, not a few scions of which, to say nothing of Irish, settled in Portugal and became true *"fijos de la Patria."*

THE BATTLE OF LA LYS AND SIGNAL COMMUNICATIONS (*To be Continued*)

In the style of an official report on this battle, sufficient details are incorporated in the text to show that the Signal Corps did heroic work for which they probably got as little credit as they do *passim*. Lieut. Col. Carlos de Barros Soares Branco, it is to be hoped, will some day write up the history of Signal Communications in Portugal.

BALLISTICS AND AEROLOGY (*Continued*)

These twin sisters are here given a pleasant dose of theory.

SPAIN

La Guerra y su Preparacion

May, 1930

STUDIES IN APPLIED HISTORY. LESSONS OF THE BATTLE OF BAILEN (*To be Continued*)

Undertaken with the collaboration of the Geographic and Historical Archives of the Spanish Army, these studies are a notable addition to the already numerous pages of military history contributed by various skilled writers. The present chapter, by Lieut. Col. D. Eduardo de F. Cervera, introduces the reader to Spain's reaction to the Napoleonic invasion with a critical appreciation of the work of organizing the army of Andalusia. The author, in conclusion, makes the significant remark that no true military organization is possible without previous preparation. Neither France during the Revolution nor Spain in 1808 fulfilled these conditions. Neither nation therefore presented the grandiose spectacle of a nation all armed, in spite of the fact that the whole male population in each, and even old men, as well as women and children, were called to the colors.

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A FRENCH AUTO MACHINE GUN WITH CHAIN DRIVE

(Taken from the *Revue de Cavallerie* of March-April, 1930)

This model, the Schneider auto machine gun, is the result of studies made in 1928 with subsequent modifications. It has been severely tested over a course of 1668 kilometers, in 14 stages, over all kinds of terrain, including cross-country and fording rivers.

ITALIAN MILITARY OPERATIONS IN LIBYA

One section of artillery used in the above has its motive power furnished by the patient camel. The account as a whole makes interesting reading.

ORGANIZATION OF THE PORTUGUESE ARMY

The artillery arm comprises: an administrative unit, or directorate; three artillery commands in the military districts of Lisbon, the Azores and Madeira, respectively; four inspecting centers, or one for each military district, an artillery school and the various troops and services belonging to this arm.

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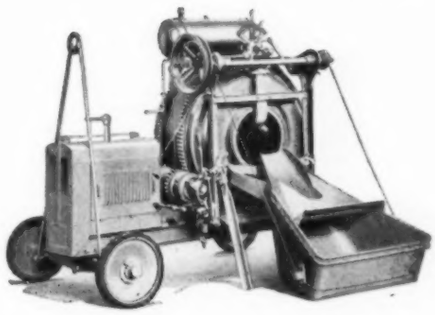

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ITALY

Revista de Artiglieria e Genio
June, 1930

THE EMPLOYMENT OF DIVISIONAL AND CORPS ARTILLERY IN AN OFFENSIVE BATTLE IN MOBILE WARFARE (*Continued and Concluded*)

Brig. Gen. Spartaco Targa devotes his final pages to a running comment on the provisions of the *Norme Divisionali* and *Norme Generali per l'Impiego delle Grandi Unita.* Tactics and strategy are eternally the same, differing in their applications only. A general officer is, of course, in a better position than anyone else to criticize or evaluate the contents of military manuals and this officer in particular has done well. *A rivederla!*

MILITARY TELPHERS

This airy vehicle, the chiefest means of inter-mountain transportation, has seldom received better theoretical treatment than Colonel of Engineers Arturo Bellusci gives it here. The present paper is a continuation of the work of Colonel Bellusci, published in the August, September and October issues of this Journal for the year 1928. 41 pages. The mathematical formulas and tables are well arranged, and the author has the gift of making his reader understand the subject—a rare faculty in articles of this kind. In his previous papers Colonel Bellusci enumerated and described various models and types of telphers used during the World War.

DETERMINATION IN THE "ELECTRIC RESERVOIR" OF THE AERODYNAMIC FIELD AROUND A PROJECTILE

A notice of some experimental determinations suggested by the studies of Prof. Ing. Carlo Ferrari published in the Proceedings of the *R. Accademia delle Scienze*, Torino, 1929. Professor Ferrari's labors were directed to the analogy between electric and aerodynamic field respectively. The writer, Ing. Filippo Burzio, considers the determinations made by him to be of high ballistic interest. He used in his experiments the apparatus recently installed in Aeronautic Laboratory of the Royal Engineer School, Turin. The Director of this School is Professor Panetti.

THE ZONES OF EFFECTIVENESS AND THE DEATH ZONES IN ANTIAIRCRAFT FIRE

OPTICAL INSTRUMENTS. METHODS OF VERIFYING COLLIMATION IN CERTAIN AIMING APPARATUS

MEXICO

Revista del Ejercito y de la Marina
June, 1930

THEORY AND PRACTICE IN WAR AS A SCIENCE AND AS AN ART

Gen. Pedro Caloca, Chief of the Mexican Air Forces, here offers a price of $50.00 to the officer writing the best essay on the subject: "In What Proportion Should Theory and Practice Enter Into an Officer's Training?"

NECESSITY OF THEORETICAL STUDY FOR PROFESSIONAL SOLDIERS

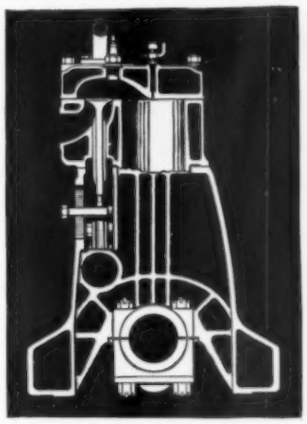
Major of Engineers Miguel Sanchez Lamego takes up the General's offer with this paper. War being both an art and a science, obviously needs both practice and study. Military schools and training in peace time furnish (it is to be hoped) ample field for the latter, as the author tells us. In studying war as a science one should follow the deductive

method, i. e., draw general conclusions from particular cases. Practice alone will make neither a soldier nor, indeed, any other professional. This, it seems, should be self-evident. Some enthusiastic advocates in other countries of a soldier's knowing about everything in the world, would have him add to strategy and tactics, fortification and logistics, a universal knowledge of six or seven sciences, adding, it might be well if in addition he boned up on geodesy and the noble science of astronomy. One is glad to find that Major Lamego doesn't go that far. For a general officer he prescribes: general tactics or, better, the use of arms in combat; field service regulations; temporary fortifications or organization of the terrain; some notion of liaison and signal communications, of transportation and of topography.

THE SERVICES OF PRACTICAL PSYCHOLOGY TO THE ARMY
(*Continued*)

The third chapter of a rather interesting and clearly conceived article, by Licenciado Ignacio Otero de la Torre. He refers briefly to the Yerkes tests made on U. S. recruits for service in Europe during the war. It is not very comforting to learn that one definite result of such tests is that 49 per cent of us Yankees have the mentality of a 13-year-old child. This, however, is putting it rather high, for tests that the reviewer himself has conducted on thirteen-year-olds shows that they know about as much as some men of twenty-five. What all similar tests fail in, is to show just what to expect from a series of given cases. To put it mildly they are about as unreliable as certain phases of the moon.

STRONG AND DEEP



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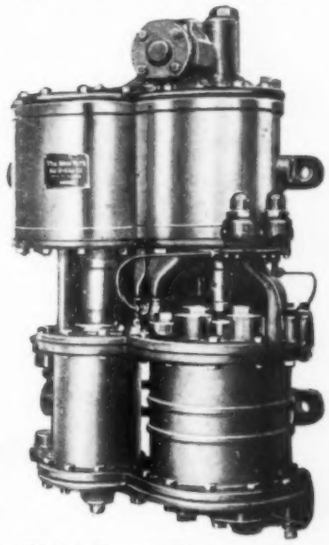

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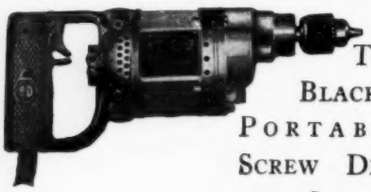

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Book Reviews

Turenne, Marshal of France. By General Max Weygand. Translated by George B. Ives. Boston: Houghton Mifflin Co. 1930. $3.50.

NAPOLEON'S estimate of Turenne is summed up in his statement that "of all the generals who have gone before me and will perhaps come after me, the greatest is Turenne." Too little known in this country, there should be a feeling of satisfaction among military students that General Weygand's biography of Turenne has been translated into English. In this book we are brought to realize the military talents of a great soldier. Turenne's innovations in strategy and tactics, his emphasis on the value of artillery fire, his utilization of movement in warfare are described in satisfactory detail and are not without practical interest to the modern soldier in spite of changes in weapons and tactics. This well-written biography is an excellent study both of a great leader and an interesting and important period in the history of Europe, including as it does the Thirty Years' War.

Principles of Strategy. By Maj. Gen. Sir F. Maurice, K. C. M. G., C. B., LL. D., with an introduction by Field Marshal Sir G. Milne, G. C. B., Chief of the Imperial Staff. New York: Richard B. Smith, Inc. 1930.

GENERAL MAURICE needs no introduction to the American reader. The authority of his name quite properly carries great weight with the military student in this country. In this book he shows the rare ability of endowing the subject of strategy with a liveliness and interest that sets him apart from the usual writer on the principles of warfare. While the British point of view is maintained in the discussions, nearly all the principles apply with equal force to our own country. When General Maurice writes "that the student of war must think of war not in terms of naval, military and air power separately but in terms of the application of national power," he confounds the narrow-minded individualist of each service and establishes the key note of his broad-minded view of the principles of war.

Grandeur and Misery of Victory. By Georges Clemenceau. Translated by F. M. Atkinson. New York: Harcourt, Brace and Company. 1930. $5.00.

CLEMENCEAU, grand old man of France, died as he had lived—full of fight. This hymn of hate might have remained unpublished if the posthumous memoirs of Marshal Foch had not been released.

Singled out for the bitterness of his attacks are Poincaré, the war-time President and post-war Premier, and Foch, the Commander-in-Chief. Side shots are fired at Pershing and Woodrow Wilson, but invariably the attack swings back to Poincaré or Foch.

The handling of the American troops in France comes in for considerable discussion. Clemenceau insisted upon

the Americans being thrown piece-meal into the line after the German break-through in the spring of 1918 instead of waiting, as Pershing insisted, until the American Army could be thrown in as a whole. Poincaré, Clemenceau and Foch agreed as to the necessity for this action, but Foch, according to Clemenceau, failed to give the necessary orders. He characterizes "Pershing, who did not want to obey, and Foch, who did not want to command."

Clemenceau also taxes Foch with ingratitude. After the Chemin des Dames disaster, the French Chamber of Deputies insisted upon the removal of Foch from the high command. Clemenceau with his pugnacious spirit resisted and won a signal victory. Later Foch wrote to Lloyd George, thanking him for preventing his removal from the supreme command.

Insubordination is alleged in that Foch after the Armistice failed to send a telegram which he had been instructed to send to the German Government. This conduct is said to have elicited from President Wilson the comment "I will not entrust the American Army to a General who does not obey his government." To avoid being superseded by Petain, Foch agreed on his honor not to behave in this way again.

Clemenceau gives President Wilson the lion's share of credit for "fixing the new laws of Europe." The French had insisted upon a guarantee pact uniting France with England and America in return for giving up the German territory on the left bank of the Rhine. The guarantee pact failed and France was left without adequate protection against Germany.

In the years since the signing of the Treaty of Versailles, "defeat substituted for victory" is the result of France's post-war course. He inveighs furiously against Foch's and Poincaré's attitude on the question of the Rhineland; at America, "caring only for her own prosperity"; at Locarno; at the Dawes plan; at the Young plan. He dubs the peace with Germany as "a retrograde peace," a thing of "abdications" to the Germans.

Two of the leading characters—Foch and Clemenceau—have passed on and have spoken. To complete the trilogy, we await the words of our own Commander-in-Chief, General Pershing.

The Sea. By H. A. Marmer. New York: D. Appleton and Co. 1930. $3.00.

THE majority of readers and travelers are not aware of the results of the various expeditions and investigations conducted with a view to obtaining detailed scientific knowledge concerning the oceans. The mystery of the sea has been gradually learned through exhaustive effort and with the aid of new inventions and devices, so that now the more frequented parts of the water portions of the earth are quite well understood.

Mr. Marmer sets forth the history of oceanography from its earlier and less extensive beginnings, which—more frequently than not—were inaccurate to a decided degree, to the present day scientific approach to such research and explains the known facts based thereon. The statistics involved and summaries of various investigations are presented most fascinatingly and in such manner as to be intensely entertaining and readily understandable. The contrast of ancient conceptions of the seas with our modern knowledge is extremely interesting.

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It has been advantageous to limit the size of this publication and of necessity much of interest has been omitted or but briefly touched upon. However, the accomplishments of the various activities instrumental in advancing the science of oceanography are sufficiently detailed to indicate the importance of the inventions and investigations of individuals and of expeditions of our country of which we may justly be proud.

The author has performed his task well and the world of books is enriched by the addition of this volume.

Siberian Garrison. By Rodion Markovits. Translated by George Halasz. New York: Horace Liveright. $2.50.

IN this book Rodion Markovits disdains to adopt the usual appeal to the modern reader of literary efforts inspired by the World War, such as heroic feats of daring or horrible and gruesome incidents attendant on mass warfare, and writes almost exclusively on matters concerning Siberian prison camps. While living in Budapest, he became drawn into the army by the vortex of preparations and all too soon found himself serving in the front lines. Little did he comprehend the causes of the war or its necessity, and what started out to be a sort of dream became transformed into an unending nightmare by his early capture by the Russians.

For practically six years he endured the hardships and privations of Siberian prison camps, saw his fellow prisoners breakdown under their sufferings, mental and physical, and revert to little better than wild beasts, with the worst sides of their characters predominant, and returned home a broken man, prematurely aged, almost three years after the Armistice. It is to be expected that men's characters change for the worse, their finer instincts are dulled and they become divested of most of the attributes of civilization under the regime to be encountered in Siberian imprisonment. That which cannot be anticipated are the thoughts and lives of the prisoners which are so ably portrayed by the author, for such things are far beyond the scope of civilized experience and knowledge.

He writes with vividness and fineness of feeling, not omitting the more sordid and base details, and displays great literary ability in handling all such matters in a masterful and unoffensive manner. The cruelty and treachery of the revolutions and counter-revolutions are described most clearly and interestingly. This book is the only one of its kind which has appeared. It presents an aspect of war which all should recognize and understand, and is unquestionably a great achievement.

English and Science. By Philip B. McDonald. New York: D. Van Nostrand Co., Inc. $2.00.

IF ineffective writing is characteristic of the scientist— and there is plenty of evidence of this frequent accusation— an attempt to help the situation should be welcome. When a book appears that so admirably points the way to the better use of English by the professional man and makes the path easy and pleasant, the author is to be congratulated. Professor McDonald in his discussion of the proper way to write reports and letters does not bring to mind the weariness of college English classes of former years. In the refreshing atmosphere of his book we gladly listen to his warnings to avoid the pompous and the commonplace.

The concluding chapters on cultural reading are interesting and helpful. The book is well adapted for use either as a textbook or for self instruction.

Introduction to College Physics. By C. M. Kilby, Ph.D. New York: D. Van Nostrand Co., Inc. $3.00.

THE author, who is professor of physics at Randolph-Macon Woman's College, has prepared a text specifically for the elementary course in physics in a college. The mathematics involved have been reduced to a minimum and illustrations used liberally. The explanations given of physical laws are clear and concise. On the other hand, this brevity has necessarily been attained by an omission of historical background and interest-awakening details which, it is thought, must be supplied by the instructor from his wider knowledge of the subject. Practical problems, with answers, are numerous throughout the book. This text is considered an excellent basis for a short course in physics where the instruction is supplemented by classroom talks and discussion.

How to Talk. By John M. Clapp and Edwin A. Kane. New York: The Ronald Press Co. $5.00.

THE authors define as their purpose "to show the reader how to make an analysis of the conditions of the type of public address in which practically everyone today has to participate, and of conversation as well; to give him a clear statement of what is expected of him, according to current standards of good form; and to suggest practical methods for improving his 'technique' at a minimum cost in effort and time." Their program has been brilliantly achieved, for this is a most satisfactory example of a book for self instruction. The text is clear and interesting, the experience of the authors is such that they are obviously well aware of the troubles of the beginner, and the suggestions are comprehensible and to the point. It is a most useful publication for anyone who has occasion to speak under any circumstances.

The American Adventure. By David S. Muzzey, Ph. D. New York: Harper and Brothers. 2 vols. $10.00.

"HISTORY is not a science, it is an art. Success in it is achieved only through the imagination," says Anatole France in discussing the paramount importance of the personality of the historian in the selection and interpretation of the facts of history. Dr. Muzzey brings to his task the requisite qualities for success, and the excellent result is what could be expected. Many of us are accustomed to regard history as a succession of "desiccated facts." We think of history, not as a chain of events showing cause and effect, action and reaction, but as a series of dates of notable occurrences with no particular analysis of their antecedent causes. Dr. Muzzey's clear-cut story of the evolution of American democracy provides the explanation for the institutions of the United States of the present through a keen and impartial analysis of the past. There is a nice proportion maintained throughout between the political, social, economic and military phases of our past with no undue emphasis on any one of these. In addition to its distinction as an unusually fine piece of historical writing, the author has succeeded in making it as readable as a novel. The American people should welcome this valuable addition to the recordings of their development.

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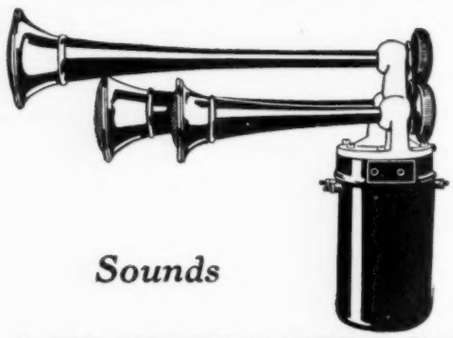

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The Seven Seals of Science. By Joseph Mayer, Ph. D. New York: The Century Company. $3.50.

DOCTOR MAYER has done for the pure sciences what Will Durant did for philosophy. Here is recorded for the educated lay reader a remarkably readable history of the basic sciences of our civilization: mathematics, astronomy, physics, chemistry, geology, biology, and sociology. These are the seven seals which the author shows us had to be broken, in the order named, that man might evolve to his present state of knowledge. In this day of extreme specialization the emphasis given here to the mutual interdependence of the various sciences is particularly valuable. This work also impresses on us that industrial progress, or applied science, is totally dependent on pure scientific research.

Doctor Mayer also tactfully reminds us of what we easily forget: That the scientific progress of the world has always been, and will always be, the result of the work of a few hard-working geniuses handicapped by the ignorance and inertia of the majority of mankind who later benefited by the work. In the realm of sociology we are shown the present confusion and future hope of man. This scholarly book which is a pleasure to read is a brilliant story of the evolution of knowledge. It is illustrated and indexed; there is no bibliography.

The Outline of Man's Knowledge: The Story of History, Science, Literature, Art, Religion, Philosophy. By Clement Wood. New York: Lewis Copeland Company. $5.00.

THE ultimate in the highly popular "outline" literature of the day has been reached in this ambitious attempt to cram into less than seven hundred pages an epitome of man's knowledge. Such an undertaking could be only partially successful at best, but it must be admitted Mr. Wood has made a valiant effort to accomplish the impossible. Unfortunately his book is marred by a number of errors such as: on page 173 "12 pence to the pound"; on page 378 "Thalatta" for "Thalassa"; on page 137, "In 1854, Pierce a Vermont democrat was elected, etc.," should read, "In 1852, Pierce, a New Hampshire democrat, etc." In spite of such errors, the book is interesting and surprisingly readable, and should be of value in stimulating the desire for deeper draughts of knowledge than it affords.

The Road to Plenty. By William T. Foster and Waddill Catchings. Boston: Houghton Mifflin Company. $2.00.

SOME years ago these authors commenced their attack on certain features of orthodox economic doctrine in a number of very effective books which have aroused widespread discussion. In the volume under consideration they reach the culmination of their constructive criticism with a proposed solution to the crying evil of periodic unemployment for great masses of workers and the other unfortunate results of recurring business depressions. In the form of an absorbing story that all can understand, we are told that savings both by individuals and corporations cause a shortage of consumer buying, unless the deficiency is made up in some way. The novel method they offer for controlling the deficiency is simple and has great promise. This is a most important book which, it is to be hoped, will be read and taken to heart by the greatest possible number of readers.

The Analysis of Financial Statements. By Harry S. Guthmann. New York: Prentice-Hall, Inc. $5.00.

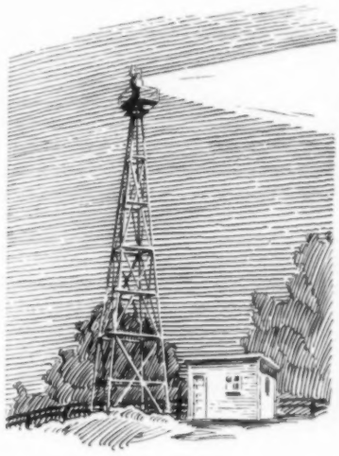
IN this volume of a little over four hundred pages, Professor Guthmann has succeeded in presenting an ample and complete exposition of the analysis of balance sheets and profit and loss statements. The first part of the book is devoted to principles of analysis with satisfactory description of the construction of both kinds of financial statements, the method of analyzing working capital and the significance of changes occurring in the balance sheet. The importance of ratio studies in the internal analysis of a business is very adequately shown. The second part of the book deals with specific cases of railroad and utility financial statements as well as those of the other important types of corporations. The meaning of the figures in these statements is clarified so that the reader will unquestionably be able to form an accurate estimate of the condition of a business and the results of its operations by the use of the methods of analysis outlined by the author.

The Nature of the World and of Man. By W. C. Allee, G. W. Bartelmez, J. H. Bretz, A. J. Carlson, R. T. Chamberlin, F. C. Cole, M. C. Coulter, H. C. Cowles, E. R. Downing, E. O. Jordan, C. H. Judd, H. B. Lemon, F. R. Moulton, H. H. Newman, A. S. Romer, and J. Stieglitz. H. H. Newman, Editor. The University of Chicago Press, Chicago, Ill. $5.00.

THE popularization of science goes on apace, but it is safe to say that no better book will be written to this end than the one under consideration. This group of University of Chicago professors, each in his special field, presents an outline of our knowledge of the physical and biological world showing the position of man in the Universe. Dr. Moulton, well known as an astronomer and ballistician, writes the introductory chapter on astronomy, followed by Professor Chamberlin on the origin of the earth. The other chapters are the product of equally authoritative writers who carefully avoid the pitfalls both of excessive superficiality and of too great detail. The book achieves its purpose admirably in presenting a thoroughly reliable interpretation of the present status of scientific knowledge.

Character and the Conduct of Life, Practical Psychology for Every Man. By William McDougall. New York: G. P. Putnam's Sons.

IF the two forces, heredity and environment, produce the resultant mind, to what extent can the individual control his character and develop it along the lines he desires? One of America's best known and best qualified psychologists gives us his answer to this problem in this extremely helpful book. "It is directed to men and women of good will who are not completely satisfied with themselves, who believe that by taking thought they may add, however little, to their moral stature and to their efficiency in working towards whatever goals they may have adopted." This hopeful doctrine by a man who knows the human mind better than most living authorities, successfully disposes of the fatalistic dogma of the human being as a mechanism incapable of influencing his destiny. Professor McDougall has given us a profoundly interesting book which, by increasing our knowledge of ourselves and others, can lead to a happier and more effective life.



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